

M&M Refrigeration, Inc.
Computer Control System

Screw Compressor Control
Sullair Retro Fit Panel

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***M&M Refrigeration Inc.,
Standard Screw Compressor Manual - Sullair
Version 200***

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The **Compressor Control System (CCS)** is an advanced microprocessor-based control system designed for efficient and automatic control and monitoring of industrial refrigeration systems including screw compressors. The controller is composed of a microprocessor board, Input/Output boards, a keypad, and a Liquid Crystal Display (LCD). The system uses the LCD to present screens to the operator for information review and control.

The Screw Compressor User's Manual provides the operator with the basic information needed to configure and operate the compressor. The manual is divided into several sections beginning with the General Operating Overview which contains system definitions, keypad functions, main LCD screen layout, screen type designations, and generic alarm & failure information.

The remaining sections of the manual cover the control functions required for operation of the compressor and detailed descriptions of the display screens found in the system. Also included are appendices covering standard communications protocols, hardware channel assignments, and alarm descriptions.

Associated Documents

Familiarity with the following M&M documents is recommended:

- *CCS Sequencer Control*

Applicable Compressor Models

This document covers the M&M Retrofit for Sullair Compressors.

The following sections will give the user an overview of the general operating procedures for the CCS.

Definitions

CCS System Manager is the person who will assign user passwords, access levels and screen access requirements.

Cursor is a field indicator used on data entry screens. There are four possible cursor types:

- * represents a number field input
- > represents a selectable field
- “ represents a string field
- X represents a hexadecimal field

The cursor shows the user which fields are changeable on a data entry screen.

Display Area is the part of the LCD display that shows system information. The display area will vary in size depending on whether a large character or small character screen is being viewed.

Fields are places where the user enters control parameters.

Highlight is when the letters appear light on a dark background instead of dark on a light background. The highlighted area may flash from light to dark to stress its importance, and to gain the user's immediate attention.

Hot Keys are the top-level system functions and menus. The hot keys are located in a column on the left side of all large character screens.

Large Character Screens are screens that use large, double high characters, and contain the title banner and hot keys.



Main Status Screen is a large character status screen, which is considered the main system status screen. This screen will also contain the alarm status, mode, and state of the system.

Parameter is a system control value, which is displayed by the system or input by the user. Examples are suction pressure and high suction pressure alarm setpoint.

Screen is a method of displaying information to the user. The system contains eight types of possible screens: menu screens, data entry screens, status screens, confirmation screens, momentary screens, information screens, access screens, and log screens

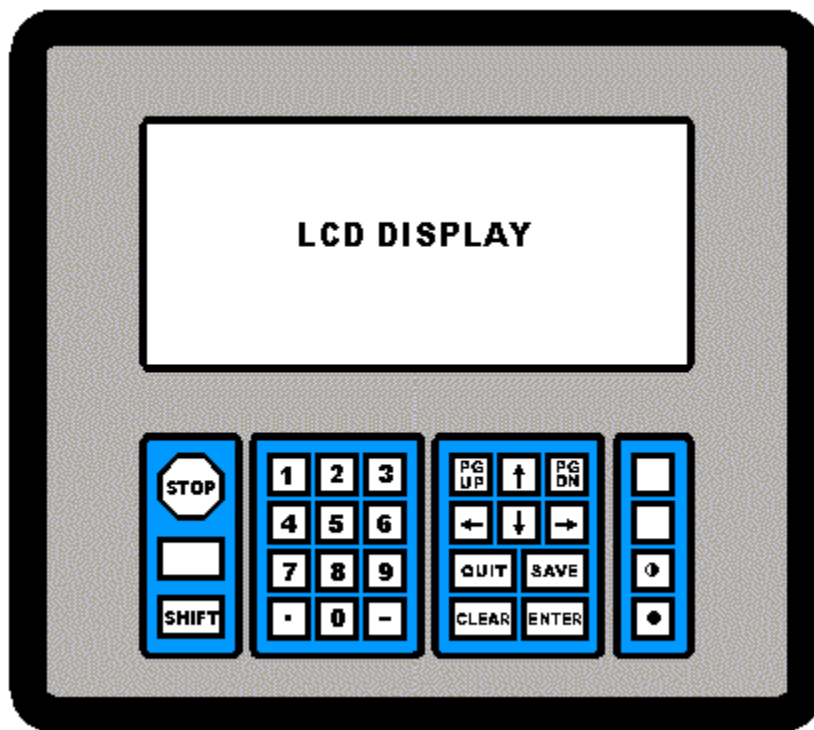
Small Character Screens utilize the entire LCD display and use small characters to show system information. These screens do not display the system hot keys.

Toggle is the process of moving from one selectable choice to the next by using the ENTER key.






User is an individual or group of individuals who will use the system. A user is identified by a user number ranging from 1 to 10. The user may also be referred to as the operator in this document.

Keypad Functions

The following is a brief summary of the CCS keypad along with a description of its individual keys. Below is a drawing of the CCS keypad layout.

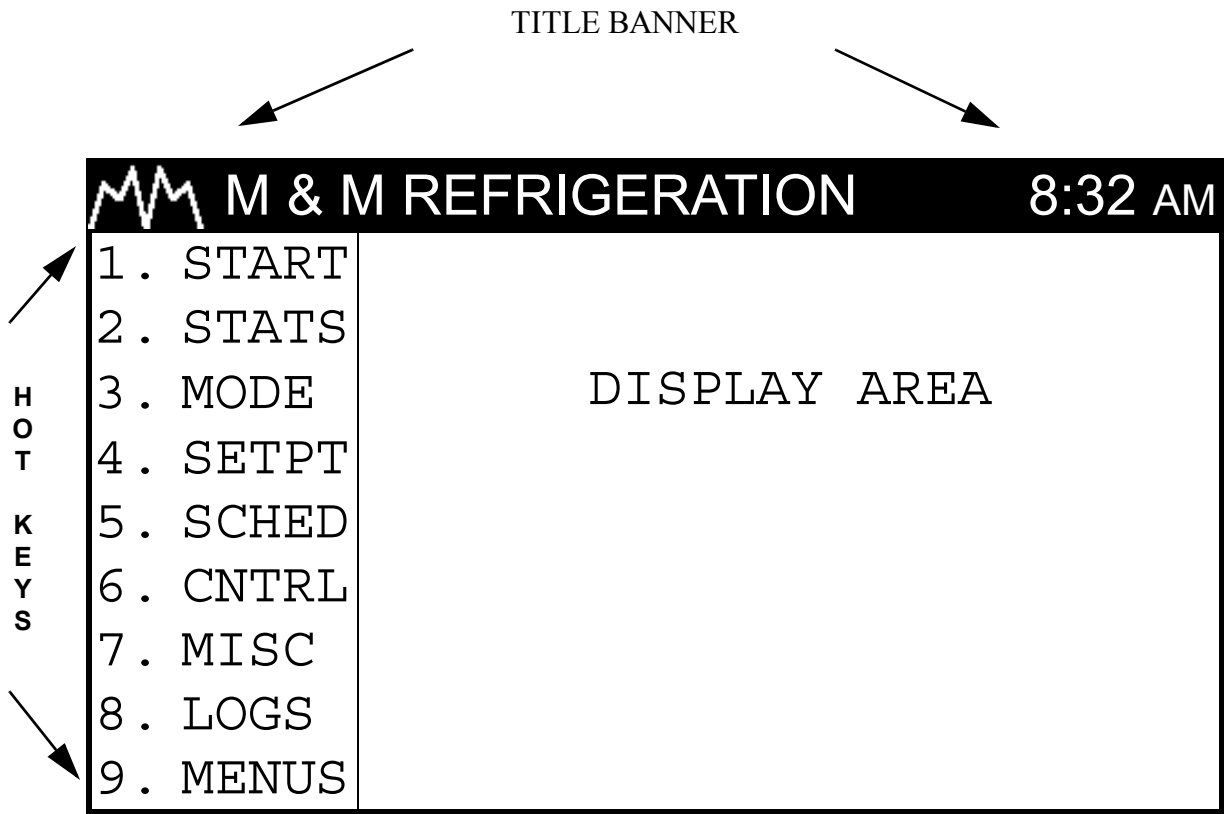


Keypad Diagram

STOP	The red STOP key causes an immediate and orderly shutdown of a compressor. This key usually has no effect on master panels.
SHIFT	The SHIFT key is used to switch control back and forth from the display area to the hot keys. This key may also be used to scroll between the horizontal pages of a log screen.
0 – 9	The NUMBER keys select menu or hot key options. On data entry screens the number keys are used to enter numerical data.
.	The DOT key allows decimal point entry on data entry screens. This key also permits the user to page forward one full screen at a time on log and status screens.
–	The MINUS key allows negative number entry on data entry screens. This key also permits the user to page back one full screen at a time on log or status screens.
	On data entry or menu screens, the UP ARROW key moves the cursor up to the next item on the screen.
	On data entry or menu screens, the DOWN ARROW key moves the cursor down to the next item on the screen.
	On data entry or menu screens, the LEFT ARROW key moves the cursor left to the next item on the screen. This key also permits the user to page forward one full screen at a time on log and status screens.
	On data entry or menu screens, the RIGHT ARROW key moves the cursor right to the next item on the screen. This key also permits the user to page back one full screen at a time on log and status screens.
PG UP	The PG UP key is used to page back one full screen at a time for status screens or to page up to more current data on log screens.
PG DN	The PG DN key is used to page forward one full screen at a time for status screens or to page down to older data on log screens.
QUIT	The QUIT key exits the current screen and displays the previous screen. Pressing the QUIT key to exit from a data entry screen will result all changed data being lost.
SAVE	The SAVE key is used with data entry screens to save any changed information. It also exits the current screen and displays the previous screen.
CLEAR	The CLEAR key within data entry screens will erase the current number field. On the main status or alarm status screen it acknowledges and clears alarms and failures.
ENTER	The ENTER key is used within data entry screens on a number field to accept numerical data or on a selectable field to toggle through the available choices. On menu screens, the ENTER key will select the highlighted menu item. The ENTER key may also be used to scroll forward through the status screens.
	The CONTRAST keys are used to adjust the display for proper viewing depending on the ambient light levels. When the desired contrast is achieved, pressing any other key will lock the current contrast value into memory.

Main Screen Overview

The **MAIN SCREEN** is the name for a set of features common to all large character screens. The Main Screen is broken down into three areas: display area, hot keys, and title banner. The following drawing shows a representation of the main screen layout and labels each of its various areas.



Main Screen Layout

Title Banner - The top highlighted bar contains the M&M logo and the current time of day and may only be found on large character screens.

Display Area - Contains all of the detailed screen information. Large character screens will use only the designated display area, while small character screens use the entire LCD display.

Hot Keys - The hot keys are a set of system functions, which are found in a column on the left side of all large character screens. They are the most frequently used functions on the CCS and allow access to all lower level menus and functions.



Hot Key Selection

1. **Verify Number next to a Hot Key is Highlighted** - one of the numbers next to a hot key should be highlighted and flashing. (This is not the same as having the hot key command highlighted.)

If there are no numbers highlighted, switch control from the display area to the hot keys by pressing the **SHIFT** key.

2. **Select Option** - use the key pad to select a corresponding option number or use the arrow keys to move the highlighted area to the desired selection and press **ENTER**.
3. **Alternate Select Option** - whenever a status screen is being displayed, a hot key may be activated by typing the hot key number. This also works on small character status screens even though the hot keys are not visible.

Screen Types

CCS information is presented to the operator using eight different types of screens. The different screen types each use specific data entry and control procedures. The screen types let the user know which screen type heading to refer to for information on the specific screens' procedures. The following is a list of the eight different screen types.

- **Menu Screen** - displays a numbered list of options.
- **Data Entry Screen** - used to modify system control parameters.
- **Status Screen** - displays real-time system summary data.
- **Confirmation Screen** - used for verification, gives a choice for a yes or no option.
- **Momentary Screen** - displays a message for three seconds.
- **Information Screen** - used to display system information
- **Access Screen** - a menu type screen with an number input field.
- **Log Screen** - displays a record of system parameters and actions.



Menu Screens

The **MENU SCREEN** is used to present the user with choices for various system operations. Menu screens are found throughout the CCS system. The following is an example of a menu screen.

M & M REFRIGERATION		8:32 AM
1 . START	SETPOINT SELECTIONS 1 . PRESSURE 2 . TEMPERATURE 3 . MOTOR CURRENT 4 . SLIDE VALUE POS	
2 . STATS		
3 . MODE		
4 . SETPT		
5 . SCHED		
6 . CNTRL		
7 . MISC		
8 . LOGS		
9 . MENUS		

Menu Screen

The following table contains a list of the active keys on a menu screen and their function.

KEYS	FUNCTION
SHIFT	Switches control back and forth between the display area and the hot keys.
NUMBER KEYPAD	Used to choose a selection number.
ENTER	Used to choose the selection number that is highlighted.
UP/DOWN ARROW	Moves the cursor from one selection to the next either up or down.
QUIT	Exits from current screen to the previous screen.

Menu Screen Keys Table

Menu Selection Procedures - Menu options are chosen similar to hot key options.

1. **Verify Cursor Control** - Verify that a menu option number is highlighted. If not use the SHIFT key to transfer cursor control from the hot keys to the display area.
2. **Menu Option Selection** - Use the number keys corresponding to the desired menu item or the arrow keys and press **ENTER** to select the desired menu item.

Data Entry Screens

DATA ENTRY SCREENS are user interactive screens, which allow the user to change or input system data. These screens contain a special cursor to signify the field type at the cursor location. The cursor can be moved throughout the screen to indicate each field location. The following is an example of a data entry screen.

M & M REFRIGERATION		8:32 AM	
1. START	OIL TEMP SETPTS		
2. STATS			
3. MODE	HIGH FAILURE	XXX.X	DEGF
4. SETPT	HIGH ALARM	XXX.X	DEGF
5. SCHED	HEATER CONTROL	XXX.X	DEGF
6. CNTRL	LOW ALARM	XXX.X	DEGF
7. MISC	LOW FAILURE	XXX.X	DEGF
8. LOGS			
9. MENUS			

Data Entry Screen

✍ **NOTE:** Data Entry screens may also contain information for reference purposes that is not changeable.



The following table contains a list of the active keys on a data entry screen and their function.

KEYS	FUNCTION
NUMBER KEYPAD	Used to enter numerical data.
ENTER	Toggles through the available choices on a selectable field. On a number field the ENTER key is used to accept entered data and move to next field.
ARROW KEYS	Moves the cursor from one field to the next either up, down, left or right. Any of the arrow keys can also be used to accept the data entered on a number field.
CLEAR	Will clear the current numerical field. The CLEAR key is not active on selectable fields.
SAVE	Exits from the current screen and all new data is saved.
QUIT	Exits from the current screen and all new data is lost.

Data Screen Keys

A data entry screen may contain both numerical input and selectable fields, which are identified by different cursors as shown in the following table.

CURSOR	FUNCTION
>	Selectable cursor, indicates a selectable field.
*	Numerical input cursor, indicates a number field.
"	String input cursor, indicates an alphanumeric string field.
X	Hexadecimal input cursor, indicates hexadecimal number field.

Data Entry Screen Cursor Table

Data Entry Procedures

1. **Verify Screen Type** - One of the special cursors must appear on the screen. If the cursor did not appear you are not on a data entry screen.
2. **Change Fields** - Use the arrow keys to move the cursor to the desired field.
3. **Enter Data** - Enter the desired numerical data or select the desired selectable depending on field type.
4. **SAVE OR QUIT** - Upon completing the changing of data the user may press **SAVE** to save all newly entered data and return to the previous screen. If the user presses **QUIT** the entered data will not be saved. After pressing **QUIT**, a confirmation screen will ask the user to verify the desire to lose all changes entered.

Field Types

This section discusses the procedures used to work with each of the field types as well as the general procedures that apply to all number entry fields. The following information applies to any field when entering numerical data:

Decimal Number Entry - If the data you wish to enter has a zero in the decimal place there is no need to enter ".0 ". Simply enter the whole number value.

Arrow Keys - The arrow keys will accept the entered data and move the cursor to the next field.

Errors - A flashing error message tells the user that the entered data is not within an acceptable range for the field. The user must clear the error before proceeding. To clear an error message the operator presses the **CLEAR** key.

Restoring Valid Data - The user can clear and re-enter data from any field prior to leaving the field. If the arrow key or the **ENTER** key is used to move off the field after it has been cleared, the previously entered valid data will be restored to the field.

Selectable Fields

A selectable field gives the user a choice of inputs from which to toggle through, and is recognized by the ">" cursor preceding it.

1. **Verify Cursor Type** - locate the ">" selection cursor.
2. **ENTER Key** - cycles the user through the available selections.
3. **Arrow Keys** - move to the next field and accept the selection.

Numerical Data Input Fields

A numerical field is used to enter control data, and is recognized by the "*" cursor preceding it.

1. **Verify Cursor Type** - locate the "*" numeric input cursor.
2. **Number Keypad** - press the number keys that correspond to the number you wish displayed. Use the decimal and minus keys where applicable. Each field will limit the user to a maximum number of whole and decimal numbers for that specific field.
3. **ENTER/Arrow Keys** - move to the next field and accept the entered number.
4. **Verify Cursor Type** - Upon pressing the **ENTER** or **DOWN ARROW** key, if the cursor moves across to the units column and changes to the ">" selectable cursor, the user is in a suction pressure field which is described in the next section.

Absolute Pressure Fields

This field is actually a combination of numerical and selectable fields. The selectable or units section of the field allows the user to adjust the units to select vacuum or non-vacuum ranges.

1. **Verify Cursor Type** - locate the "*" numeric input cursor.
2. **Number Keypad** - press the number keys that correspond to the number you wish displayed. Use the decimal and minus keys where applicable. If the numeric field already has the correct data and only the units need to be adjusted, re-enter the existing numerical data and press **ENTER**.



3. **ENTER/Arrow Keys** - locks in the numerical data and moves the cursor across to the units section of the field.
4. **Verify Cursor Type** - locate the ">" selection cursor next to the units section.
5. **ENTER** - cycles between possible units selections.
6. **Arrow Keys** - move to the next field and accept the entered data.
7. **Errors** - If an error occurs because the value entered is out of range the **CLEAR** key will clear the field and return the user to the number portion of the field.

Time Fields

The time field is a special case numerical field used to enter time data.

1. **Verify Cursor Type** - locate the "*" numeric input cursor.
2. **Number Keypad** - use the number keys to enter the time you wish displayed. For example, to input the time 5:59 press 0559, the system automatically moves from hours to the minutes. The ":" is automatically entered in a time field. This field will allow for whole number acceptance. For example to set the time 8:00 the user may type 08 and press **ENTER**. The time on the screen will appear as 08:00. It should be noted that time fields may be entered in 12-hour or 24-hour format depending on the system configuration. If the system is in 12-hour format the user will be prompted to select "AM" or "PM" using a selectable field after a number is entered.
3. **Arrow Keys** - move to the next field and accept the entered time.

Date Fields

The Date field is a special case numerical entry field used to enter the date.

1. **Verify Cursor Type** - locate the "*" numeric input cursor.
2. **Number Keypad** - use the number keys to enter the date you wish displayed. For example, to enter the date 1/1/91 the user would type in 010191, the system automatically moves from the month to the day and then to the year. The "/" slash symbol is entered for you.
3. **Arrow Keys** - move to the next field and accept the entered date.

String Fields

The String field is a special case alphanumeric entry field. It is similar to a selectable field but each character in the string may be selected from the list of all-possible letters, numbers, and special characters.

1. **Verify Cursor Type** - locate the " " string input cursor.
2. **Enter Key** - Pressing the **ENTER** key first will clear the current contents and start entering characters. The **ENTER** key is primarily used to cycle through the available selections for the current character positions.

3. **“.” Key** - Selecting the **Period** (.) key puts the field into edit mode and allows the current contents of the field to be entered.
4. **Arrow Keys** - Allows you to move within a field to different characters.
5. **Number Keys** - These keys are used to enter numbers into a character.
6. **Clear Key** - This key is used to clear the contents of the entire field.
7. **Entering a space** - If a space is allowed in the field, an “_” will be available in the character list. Selecting this character will result in a space being inserted in the string. All trailing spaces are eliminated.

Telephone Number Field

The **TELEPHONE NUMBER** field is a special case alphanumeric entry field. It is similar to a string field but only allows numbers and several special characters required for telephone numbers.

1. **Verify Cursor Type** - locate the " " string input cursor.
2. **Enter Key** - Pressing the **ENTER** key first will clear the current contents and start entering characters. The **ENTER** key is primarily used to cycle through the available selections for the current character positions.
3. **“.” Key** - Selecting the **Period** (.) key puts the field into edit mode and allows the current contents of the field to be entered.
4. **Arrow Keys** - Allows you to move within a field to different characters.
5. **Number Keys** - These keys are used to enter numbers into a character.
6. **Clear Key** - This key is used to clear the contents of the entire field.
7. **Entering a space** - If a space is allowed in the field, an “_” will be available in the character list. Selecting this character will result in a space being inserted in the string. All trailing spaces are eliminated.

Hexadecimal Fields

The **HEXADECIMAL** Field is a special case alphanumeric entry field. It is similar to a string field but only allows numbers and several special characters required for hexadecimal numbers.

1. **Verify Cursor Type** - locate the " " string input cursor.
2. **Enter Key** - Pressing the **ENTER** key first will clear the current contents and start entering characters. The **ENTER** key is primarily used to cycle through the available selections for the current character positions.
3. **“.” Key** - Selecting the **Period** (.) key puts the field into edit mode and allows the current contents of the field to be entered.



4. **Arrow Keys** - Allows you to move within a field to different characters.
5. **Number Keys** - These keys are used to enter numbers into a character.
6. **Clear Key** - This key is used to clear the contents of the entire field.
7. **Entering a space** - If a space is allowed in the field, an " " will be available in the character list. Selecting this character will result in a space being inserted in the string. All trailing spaces are eliminated.

Status Screens

STATUS SCREENS are used to display a summary of significant system information. The main Status screen in a system is usually a large character text screen or graphics screen and is the default screen displayed on the LCD. The main Status screen will be replaced by the Active Alarm and Failure screen when a new alarm or failure exists or by the Auto-Start Warning screen if the compressor is online and ready to start.

The operator may view each of the system's available status screens by scrolling through using the ENTER, PG UP, PG DN, Right Arrow, or Left Arrow keys. The number of status screens on a system will vary depending upon the individual system's configuration.

Another feature of the system is that it will automatically return to the main status screen after 10 minutes of no keyboard activity. Below is an example of a Status screen.

M & M REFRIGERATION				8:32 AM	
1 . START	SY	XXX.X	PSIG	MA	XXX.X AMPS
2 . STATS	SP	XXX.X	PSIG	ST	XXX.X DEGF
3 . MODE	DP	XXX.X	PSIG	DT	XXX.X DEGF
4 . SETPT	OP	XXX.X	PSIG	OT	XXX.X DEGF
5 . SCHED	OF	XXX.X	PSIG	OS	XXX.X DEGF
6 . CNTRL				PT	XXX.X DEGF
7 . MISC	SV	XXX	PCT		
8 . LOGS					
9 . MENUS		RUN-TRIM		SEQ	NORM

Status Screen


The following table contains a list of the active keys on a status screen and their function.

KEY	FUNCTION
SHIFT	Switches control between the display area and the hot key options.
ENTER	Scrolls through the set of available status screens.
PG UP/PG DN/ RIGHT/LEFT ARROWS	Pages forward or back through the available status screens.
QUIT	Returns the user to the main status screen.

Status Screen Keys

Confirmation Screens

A **CONFIRMATION SCREEN** is used to ask the user to confirm a selection by answering a question. This screen usually appears after the user has altered system parameters and then presses the **QUIT** key or, to verify a system control request. Below is an example of a confirmation screen.

 M & M REFRIGERATION 8:32 AM	
<ul style="list-style-type: none"> 1. START 2. STATS 3. MODE 4. SETPT 5. SCHED 6. CNTRL 7. MISC 8. LOGS 9. MENUS 	<p>VERIFY</p> <p>COMPRESSOR ONLINE</p> <p>1.NO</p> <p>2.YES</p>

Confirmation Screen



The following table contains a list of the active keys on a confirmation screen and their function.

KEYS	FUNCTION
NUMBER KEYPAD	Used to select a response number.
ENTER	Used to select the highlighted response number.
UP/DOWN ARROWS	Moves the cursor from one selection to the next, either up or down.
QUIT	Exits from the current screen to the previous screen. Same as selecting NO for most screens or YES when quitting from a data entry screen after making changes.


Confirmation Screen Keys

Confirmation Screen Procedures

Number Keypad - Use the keypad to match your response with the numerical choices shown on the screen or press **QUIT** to exit the screen.

Momentary Screens

The **MOMENTARY SCREEN** is used to verify certain user selections by displaying an informative message for three seconds. Rather than waiting for the entire three second time to elapse, the operator may press the **QUIT** key to end viewing of the message. The following is an example of a momentary screen.

 M & M REFRIGERATION 8:32 AM	
1 . START	<p style="text-align: center;">AUTOMATIC MODE</p> <p style="text-align: center;">ENABLED</p>
2 . STATS	
3 . MODE	
4 . SETPT	
5 . SCHED	
6 . CNTRL	
7 . MISC	
8 . LOGS	
9 . MENUS	

Momentary Screen

The following table contains a list of the active keys on a momentary screen and their function.

KEY	FUNCTION
QUIT	Stops display of the message before the three second time limit expires.

Momentary Screen Keys

System Information Screens

SYSTEM INFORMATION screens are used to display system data to the user. The information on these screens may be real-time data or, a snapshot of data at the time the screen is first displayed.

SYSTEM INFORMATION				day	mm/dd/yy	hh:mm:ss				
M&M REFRIGERATION INC. COPYRIGHT 1991-2001					FRAME STATISTICS					
					F0	F1	F2	F3		
M&M SCREW	day	mm/dd/yy	hh:mm:ss	v1.00	----	----	----	----		
MEMORY INITIALIZED	:	mm/dd/yy	hh:mm:ss	MAX	:	xxxx	xxxx	xxxx	xxxx	
SYSTEM LAST RESET	:	mm/dd/yy	hh:mm:ss	AVG	:	xxxx	xxxx	xxxx	xxxx	
CURRENT TIME	:	mm/dd/yy	hh:mm:ss	day	MIN	:	xxxx	xxxx	xxxx	xxxx
TIMER STATUS	:	0 OF 0 MAX: 0								
REFRIGERANT	:	R717	SEQUENCED	:	NO	LUBE SYSTEM	:	NO	PUMP	
NETWORK CONTROL	:	NO	REMOTE	:	NO	UNLOAD SOL	:	N/OPEN		
BYPASS SOL	:	NO	AUTO-REMOTE	:	NO					
ECONOMIZER SOL	:	NO	PROCESS TEMP	:	NO					
VARIABLE VI	:	NONE	MODEM	:	NO					

System Information Screen

The following table contains a list of the active keys on an information screen and their function.

KEY	FUNCTION
QUIT	Exits from current screen to the previous screen.

System Information Screen Keys



Access Screens

The **ACCESS SCREEN** is used to index the user into a larger set of screens. This screen is typically used in cases where more than eight screens are available for a particular option. The Access screen will perform error checking on the number entered. For example, if the screen is used to access the daily schedules and the number eight is entered, the input area will flash **ERROR** since there are only seven possible schedules. The user will be required to clear the error and enter a correct value. The data entry process is described in more detail in the data entry section. The following is an example of an access screen.

M & M REFRIGERATION		8:32 AM
1 . START	DAILY SCHEDULES	
2 . STATS		
3 . MODE	ENTER SCHEDULE (1 - 7) xxx	
4 . SETPT		
5 . SCHED		
6 . CNTRL		
7 . MISC		
8 . LOGS		
9 . MENUS		

Access Screen

The following table contains a list of the active keys on an access screen and their function.

KEYS	FUNCTION
SHIFT	Switches control back and forth between the display area and the hot keys.
NUMBER KEYPAD	Used to enter a number selection.
ENTER	Used to accept the selection number that is entered.
QUIT	Exits from current screen to the previous screen.

Access Screen Keys

Log Screens

LOG SCREENS are used to view recorded system information. The width and length of the log screens may be wider and longer than allowed by the LCD display area. The arrow and page keys can then be used to view the entire log. All systems are configured with the following logs: Operation Log, Trend Log, Alarm Log, Failure Log, and User Log. Other log types may also be included, depending on system options. Below is an example of a log screen.

PAGE 1/3			OPERATIONS LOG				day mm/dd/yy hh:mm:ss			
TIME	DATE	TYPE	ENTRY	DESCRIPTION	ALARM	CNTRL	CNTRL	MODE	STATE	
					LEVEL	SETPT	PARAM			
#/" /F	#/" /F									
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	ALARM	SUCTION	PRESSURE	LOW	XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG				XXX.X#	XXX.X#	AUTO	RUNNING	

↑/↓ = SCROLL, PG UP, PG DOWN, ←/→ = PAGE LEFT/RIGHT, CLEAR = TOP OF PAGE

Log Screen

The following table contains a list of the active keys on a log screen and their function.

KEY	FUNCTION
SHIFT	Pages horizontally through the information not immediately visible on the log screen.
PG UP/ PG DN	Allows the user to page forward and back through the log entries. PG UP shows more recent log entries and PG DN shows older log entries.
UP/DOWN ARROWS	Scrolls line by line through the information. The Up arrow shows more recent log entries and the Down arrow shows older log entries.
RIGHT/LEFT ARROWS	Scrolls to additional log pages while maintaining the same time and date for log entries.
CLEAR	Returns the user to the beginning of the log.
QUIT	Exits from current screen to the previous screen.

Log Screen Keys



Alarms & Failures

The **CCS** continually monitors the system parameters and compares them to alarm and failure setpoints to inform the operator of the system status. An alarm is intended to alert the operator that an undesirable condition exists. A failure is an indication that a more severe system condition exists and may cause the system or component to shutdown. The system parameters are compared to both operator-defined setpoints, and M&M Original Equipment Manufacture (OEM) safety setpoints. An alarm or failure is detected when a system parameter is outside the acceptable range of the setpoints.

Certain alarms and failures may also be suppressed under specific conditions. For example, the low oil pressure alarm is suppressed when the compressor is not running. Additionally, the detection of certain alarms and failures can be delayed. For example, the low suction pressure failure is delayed for 10 seconds, in other words the suction pressure must be below the low failure setpoint for 10 consecutive seconds before the system is shutdown.

Some alarm and failure setpoints are assigned factory default values, which may not be changed by the operator. These are called OEM safety setpoints and typically indicate a condition that may cause damage to the equipment. A detailed list of all system alarms and failures can be found in Appendix A.

When an alarm or failure is detected the sequence of operations is as follows:

The equipment controlled by the CCS may be stopped, as in the case of a compressor, when a failure occurs.

The alarm or failure is entered into the active alarm and failure list and the current status screen on the display is replaced with the active alarm and failure screen.

An entry is made in the appropriate alarm or failure log.

A special entry is made in the operation and trend logs listing the parameter values at the time of the alarm or failure.

The current alarms and failures present on a system can be viewed on the active alarms & failures status screen. The operator must acknowledge and clear alarms/failures from this screen or the main status screen using the procedures covered in this section.

When a new alarm or failure becomes active, the Active Alarm & Failure status screen will be displayed as the default status screen. The user can view all of the active alarms by scrolling through the alarms using the up and down arrow keys. An example of the alarm & failure status screen is shown below.

M & M REFRIGERATION

8:32 AM

1. START

2. STATS

3. MODE

4. SETPT

5. SCHED

6. CNTRL

7. MISC

8. LOGS

9. MENUS

ACTIVE ALARMS & FAILURES

HH:MM:SS

TYPE

DESCRIPTION

STATE

HH:MM:SS

TYPE

DESCRIPTION

STATE

state

mode

alarm

Active Alarms & Failures Status Screen

The active function keys for this screen are described in the following table.

KEY	FUNCTION
SHIFT	Switches control between the display area and the hot keys.
UP/DOWN ARROWS	Scrolls line by line through the information.
CLEAR	The CLEAR key is used to acknowledge and clear alarms/failures as well as to silence the alarm horn.

Alarm & Failure Screen Keys

Use the following steps to acknowledge and clear any alarms & failures.

1. **Verify Screen Type** - The alarm & failure status screen or the main status screen should be displayed.
2. **Acknowledging an Alarm or Failure** - Press the **CLEAR** button. When the **CLEAR** button is pressed the previously flashing "**ALARM**" or "**FAIL**" in the lower right-hand corner of the screen will stop flashing and go to a constant highlight. This action will also deactivate the alarm or failure discrete output. When multiple alarms are active, the acknowledging function operates on the entire set of active alarms or failures.
3. **Correct Problem** - The operator must now correct the problem causing the alarm or failure. This may be a control parameter that is out of range, or various other conditions which should be familiar to the operator.
4. **Clear Alarm or Failure** - Once the problem is rectified press the CLEAR button on the keypad. The alarm & failure status area should become non-highlighted and display the word "NORM", the entry in the active alarm list will also be removed. The clearing of each alarm is processed when the conditions causing the alarm are acceptable.



The following sections discuss the standard and optional features contained in the **CCS** Screw Compressor package.

Modes Of Operation

The Screw Compressor package has several modes of operation. The mode is changed by using the **MODE** hot key and making a selection from the operation mode menu. The modes of operation are as follows:

1. **Manual** - Starting, Stopping and Capacity Control are all performed manually.
2. **Automatic** - Starting and Stopping can be performed manually or automatically based on Suction Pressure or Process Temperature. Capacity Control is performed automatically to maintain a specific control setpoint.
3. **Remote** - Starting and Stopping are performed using the external Remote Start/Stop input or from a remote computer if network communications are enabled. Capacity Control is performed using external load and unload inputs or messages from a remote computer. A set of discrete outputs are available for remote status information.
4. **Auto-Remote** - Similar to the Automatic mode except starting and stopping are performed using the external Remote Start/Stop input or messages from a remote computer. The setpoint group can also be selected from external signals or a remote computer.
5. **Sequenced** - This mode is utilized when two or more compressors are being used to control the same load.
6. **Local** - When the compressor is in Local mode, Starting, Stopping, and Capacity Control are identical to the Manual mode. The only difference is that when the compressor is in Local mode, users at remote control locations do not have the ability to control the compressor or change the mode.

*✍ **NOTE:** The Remote, Auto-Remote, and Sequenced modes are available as system options.*



Lubrication System

The Sullair compressor control assumes that the compressor is equipped with a shaft driven oil pump that runs whenever the compressor is running. Control of an optional electric pre-lube oil pump is also provided. The pre-lube pump option is enabled using a dip switch on the main board. When dip switch SW3 switch 1 is in the **ON** position, a pre-lube pump is assumed to be present.

Oil Pressure Calculations

The Sullair screw compressor control has two options for calculating oil pressure. On most models, the oil pressure is calculated over discharge pressure using the equation:

$$\text{Oil Pressure} = \text{Oil Pressure After Filter} - \text{Discharge Pressure}$$

On certain Models (some labeled Series B), the oil pressure is calculated over suction pressure using the equation:

$$\text{Oil Pressure} = \text{Oil Pressure After Filter} - \text{Suction Pressure}$$

Selection of the type of oil pressure computations is done using a dip switch on the main board. Dip switch SW3 switch 2 in the **ON** position, indicates that the oil pressure is computed over suction pressure. Please review the compressor manufactures information to determine which computation should be used for the installed equipment.

The oil filter differential pressure is always computed using the equation:

$$\text{Oil Filter Pressure} = \text{Oil Pressure Before Filter} - \text{Oil Pressure After Filter}$$

Slide Valve Indicator Options

The Sullair compressor control has two possible options for slide-valve indication. Some units are fitted with a potentiometer that allows the position of the slide valve to be monitor in a continuous fashion from 0 - 100% of it's travel. Another option is to utilize the limit switches on the electric capacity control motor to indicate minimum slide valve position and maximum slide valve position. I/O is provided to read in these limit switches if required. The main status screen will display position as a percent if a potentiometer is present, and will display the position as MIN POSITION, PARTIAL LOAD, or FULL LOAD if the limit switches are utilized. The type of slide valve indication is selected using a dip switch on the main board. Dip switch SW3 switch 3 in the **ON** position, indicates that the limit switches are being utilized. Dip switch SW3 switch 3 in the **OFF** position, indicates that a position potentiometer is present.

Starting the Screw Compressor

The **STARTING** sequence for the Sullair compressor control varies based on the lube system selected as described below:

1. If a pre-lube pump is present, the pump is started
2. During pre-lube, the oil pressure must rise above 10 PSIG and remain there for six consecutive seconds. If the oil pressure fails to meet this requirement within five minutes, the compressor will be failed on "OEM START OIL PRESS LOW"
3. The slide valve is unloaded and must move to below 5% (or MIN POSITION if no indicator). If the slide valve fails to meet this requirement within five minutes, the compressor will be failed on "FAIL START SLIDE POSN HIGH"
4. Once the above conditions have been met, the motor is started, liquid injection is enabled, the oil heaters are turned off, and the Anti-Cycle timer starts counting.
5. Once the motor is started, the slide valve is monitored and must remain below 10% (or MIN POSITION if no indicator) while the motor comes up to speed. If the slide valve moves above this position, the compressor will be failed on "FAIL START SLIDE POSN HIGH".
6. Once the motor starts, the motor starter auxiliary must close within 3 seconds or the compressor will be failed. The motor starter auxiliary must remain closed while the motor is running or the compressor will be failed. The failure generated for these conditions varies based on the motor current value. Please refer to Appendix A for the list of motor starter failures.
7. Once the motor starts, the oil pressure is monitored to make sure it rises above the OEM Low oil pressure failure setpoint (20 PSIG). If at the end of fourteen seconds, the oil pressure is not above this setpoint, the compressor is failed on "FAIL START OIL PRESSURE LOW"
8. Once the motor comes up to speed (15 Seconds), the compressor transitions to the running state, the pre-lube oil pump (if available) is stopped and capacity control can begin.

The Screw Compressor can be started manually, automatically, or remotely based on the operating mode chosen. The compressor will not start in any mode if a failure condition exists.

Manual Start

MANUAL START is accomplished by selecting the **START** hot key and answering yes to the start confirmation screen. A manual start is used in Manual mode, Local mode, or Automatic mode when automatic start/stop is disabled.

Automatic Start

In **AUTOMATIC START** the compressor can be started automatically based on suction pressure or process temperature. Automatic Starting is enabled on the Miscellaneous Control screen under the **MISC** hot key. Once the Auto Start/Stop feature is enabled the operator must place the compressor on-line using the **START** hot key. If the compressor is



not needed at that time it will immediately go to the Cut-Out state and will start automatically whenever required. If the control parameter is already above the Cut-In setpoint, the compressor will start immediately. A failure or manual stop will take the compressor off-line.

Remote/Auto Remote Start

I/O Control

When remote operation is desired using discrete I/O signals, the Remote Start/Stop input is used to start and stop the screw compressor in the Remote mode and the Auto-Remote mode. In both modes, the compressor must first be placed on-line by the operator through the use of the **START** hot key. Once the compressor is on-line, the Remote Start/Stop input may be energized to start the compressor. When the input is de-energized, the compressor will stop but remain on-line. A failure or manual stop command will stop the compressor and force it off-line.

✍ **NOTE:** Before the remote location can control the system, the user must set the operating mode, and place the screw compressor on-line using the **START** hot key. Then, and only then, is the system ready to accept remote control signals.

Network Control

When the **NETWORK COMMUNICATIONS** option is enabled, starting in the Remote or Auto-Remote mode is performed using messages from a remote computer. It is required that the compressor be placed on-line via the keypad or using an on-line message. For more information on Network Operation, please refer to Appendix C.

Sequenced Start

In **SEQUENCED START**, the compressor takes commands from an M&M Master Sequencer Control Panel. The Sequenced mode can be selected from the operating modes menu under the **MODE** hot key. Once this mode is selected the screw compressor must be placed on-line by using the **START** hot key. Only when the screw compressor is placed on-line will the CCS respond to control signals from the master sequencer.

Stopping the Screw Compressor

The stopping sequence is as follows:

1. The Motor is stopped.
2. Once the starter has disengaged the slide valve is moved to the fully unloaded position (below 5% or MIN POSITION if no indicator). If the slide valve does not respond within 5 minutes the stop sequence is failed on "STOP SLIDE VALVE POSN HIGH".
3. The Liquid Injection is turned off and the oil temperature is regulated using the oil heaters.

The Screw Compressor can be stopped manually or automatically depending on the operating mode. Any failure will automatically stop the compressor.

Manual Stop

A **MANUAL STOP** is accomplished by using the stop button on the **CCS** panel. The stop button is active on all screens and causes an immediate shutdown of the motor. Use of the manual Stop button will also take the compressor off-line.

Automatic Stop

When the Auto Start/Stop feature is enabled and the compressor is in the Automatic mode, the compressor will stop automatically when the control parameter falls below the cut-out setpoint.

Remote/Auto Remote Stop

I/O Control

When remote operation is desired using discrete I/O signals, the Remote Start/Stop input signal is used to stop the compressor for the Remote and Auto-Remote modes. When the Remote Start/Stop input is de-energized, the compressor will stop but remain on-line. A Failure or manual Stop command will stop the compressor and force it off-line.

Network Control

When the **NETWORK COMMUNICATIONS** option is enabled, stopping in the Remote and Auto-Remote modes is performed using messages from a remote computer. Separate messages are available to stop the compressor and leave it on-line, or to stop the compressor and force it off-line. For more information on network operation, please refer to *Appendix C*.

Sequenced Stop

When the **STOP** command is received from the master sequencer, the CCS will stop the screw compressor automatically and leave it on-line for sequenced operation. While stopped on-line, the compressor is available for sequencing and in standby waiting for commands.



Capacity Control

CAPACITY CONTROL on the screw compressor is performed by adjusting the position of the slide valve. Loading the slide valve increases the compressor capacity. Unloading the slide valve decreases the compressor capacity. Capacity Control can be performed manually or automatically depending on the mode of operation.

Manual Capacity Control

In **MANUAL** or **LOCAL** mode the slide valve is adjusted using the keypad on the CCS. The up-arrow is used to load the slide valve and the down arrow to unload the slide valve. The **CLEAR** button is used to stop loading or unloading. Manual Capacity Control can only be performed when viewing the main Status screen or the graphics status screen.

Automatic Capacity Control

AUTOMATIC CAPACITY CONTROL is accomplished by moving the slide valve to load and unload the compressor in response to changes in the control parameter (suction pressure or process temperature). The slide valve movement is achieved using a time proportional control strategy. The operator can define Cut-In, Cut-Out, and Control setpoints. These setpoints are referred to as a Control Group. The active control group can either be selected manually by using the active group screen or automatically through setpoint scheduling. The operator can also define a minimum and maximum slide valve position which is used as lower and upper limits for the slide valve during automatic capacity control operations.

Control Groups

Four groups of control setpoints can be defined for use with automatic capacity control. Each setpoint group consist of a cut-in, cut-out, control, and low alarm and failure setpoints. The control associated with these pressures is as follows;

Cut-Out Setpoint - The **CCS** will stop the compressor when the suction pressure or process temperature goes below the cut-out setpoint.

Cut-In Setpoint - The **CCS** will start the compressor when the suction pressure or process temperature goes above the cut-in setpoint.

Control Setpoint - The **CCS** will adjust the slide valve position in an attempt to maintain the suction pressure or process temperature at the control setpoint.

Low Alarm/Failures Setpoints - These are the low suction pressure or process temperature alarm and failure values associated with the control setpoint. In Sequenced mode, the local setpoints are replaced by the Sequencer low alarm and failure setpoints transmitted by the master sequencer controller.

Time Proportional Control Strategy

The length of time the slide valve is moved during automatic capacity control is determined by a time proportional control strategy. The slide valve move time is proportional to the difference between the control parameter and the control setpoint. The parameters that define the move time are bandwidth, deadband, short pulse, long pulse, and slide valve update time. These parameters are defined for both load and unload conditions by the operator. The definition and description of these parameters is as follows:

Deadband - When the difference between the control setpoint and the control parameter is less than the deadband value no slide valve movement will take place. If the deadband values are too small, the slide valve may continuously hunt for the proper setting very close to the control setpoint resulting in excessive slide valve wear. If the deadband values are too large, the compressor may not hold the control parameter close enough to the control setpoint resulting in inefficient capacity control.

Short Pulse - This is the shortest amount of time the slide valve is moved to load or unload the system. The short pulse time is the fine adjustment for control parameter differentials slightly above or below the deadband values. If the shortest pulse is too long the slide valve may continuously overshoot the optimal position resulting in excessive slide valve wear.

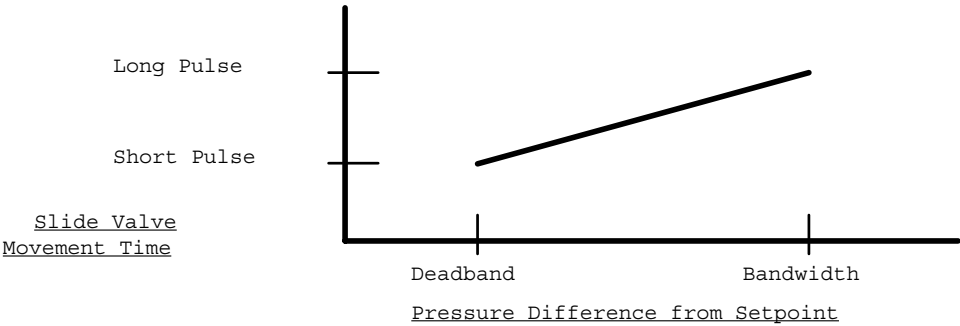
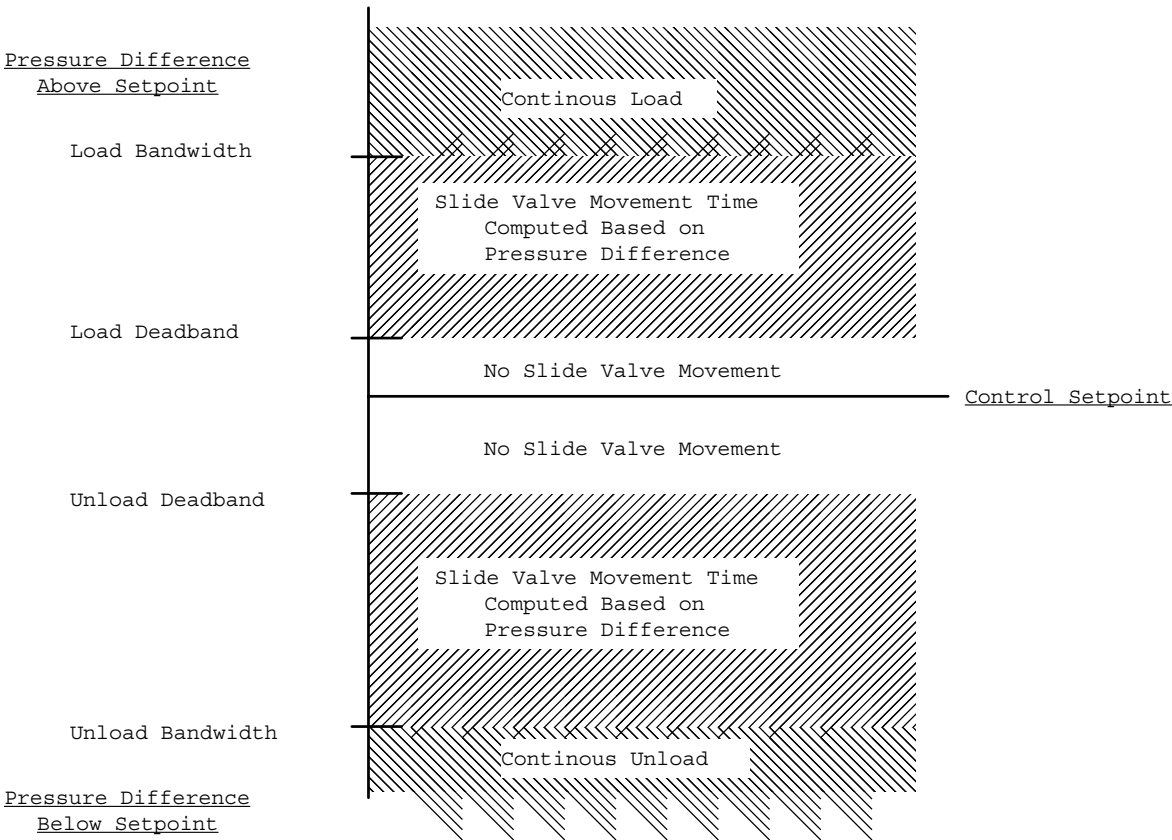
Bandwidth - This parameter adjusts the overall sensitivity of the control strategy. The slide valve move time is computed to be between the shortest and longest pulse while the control parameter is outside the deadband but inside the bandwidth. The move time approaches the longest pulse time as the difference between the control parameter and the control setpoint approaches the bandwidth value. If the bandwidth value is too small, the compressor will respond quickly and may constantly overshoot the optimal position. If the bandwidth values are too large the compressor will react slowly to control parameter changes. While the control parameter is outside the bandwidth values the slide valve is continuously loaded or unloaded.

Long Pulse - This is the longest amount of time used to move the slide valve while loading or unloading the compressor. This time period is used when the control parameter differential is equal to the bandwidth value. If the longest pulse is too long the compressor may overshoot the optimal position. If the value is too short the slide valve will react slowly to large changes in the control parameter.

Update Time - This is the time interval between computations of slide valve move time. Once a required move time is calculated the **CCS** waits the update time interval before another computation is made. This time is normally greater than or equal to the long pulse.

The relationship of these parameters can be seen in the time proportional control strategy diagrams shown below:





Time Proportional Control Strategy Diagrams



Remote Capacity Control

I/O Control

When remote operation is desired using discrete I/O signals, and the compressor is in the Remote mode, capacity control is performed using the Remote Load and Remote Unload inputs. The relationship of these signals to slide valve movement is shown in the following table.

NOTE: Remote Capacity Control is only active while the screw compressor is running.

REMOTE LOAD	REMOTE UNLOAD	SLIDE VALVE MOVEMENT
Low	Low	Holding
High	Low	Loading
Low	High	Unloading
High	High	(Should not be used)

Network Control

When the **NETWORK COMMUNICATIONS** option is enabled, and the compressor is in the Remote mode, capacity control is performed using load and unload messages from a remote computer. For more information on network operation, please refer to *Appendix C*.

Auto-Remote Capacity Control

I/O Control

When remote operation is desired using discrete I/O signals, and the compressor is in the **AUTO-REMOTE** mode, capacity control is performed using Automatic Capacity Control. Remote Setpoint signals A and B are used to select the current active setpoint group to be used for automatic capacity control in the Auto-Remote mode. The input settings for the different group numbers are shown in the following table.

GROUP NUMBER	REMOTE SET-POINT A	REMOTE SET-POINT B
1	Low	Low
2	High	Low
3	Low	High
4	High	High

The operator can enable and disable Remote setpoint selection from the Miscellaneous Control screen under the **MISC** hot key.

NOTE: Scheduling should be disabled when the Remote setpoint selection feature is enabled.



Network Control

When the **NETWORK COMMUNICATIONS** Network Communications option is enabled, and the compressor is in the Auto-Remote mode, capacity control is performed using Automatic Capacity Control. The control setpoint is selected using setpoint messages from a remote computer.

Sequenced Capacity Control

While in the **SEQUENCED** mode, Automatic Capacity Control is used to adjust the slide valve as documented above. When a sequenced compressor is on-line, one of the following three commands will be sent from the master sequencer controller.

- **Trim** When the trim command is sent from the master sequencer, the CCS will start the screw compressor. The Control Parameter and Control Setpoint will be also be sent from the master, and the compressor will begin making slide valve adjustments using Automatic Capacity Control. Once the compressor is started, the status area will display RUN-TRIM indicating that the trim command was received.
- **Full Load** When the Full Load command is sent from the master sequencer, the CCS will force and hold the slide valve at the fully loaded position. When the Full Load command has been received, the status area will display FULL LOAD.
- **Seq-Stop** When the Seq Stop command is received from the Master Sequencer the CCS will stop the screw compressor automatically and leave it on-line for sequenced operation.

Low Alarm and Failure Setpoints

When Sequenced mode is enabled and the compressor is online or running, the local **LOW ALARM AND FAILURE SETPOINTS** are replaced by the Sequencer low alarm and failure setpoints. This is true for both Suction Pressure and Process Temperature operation. The local sensor is still used to generate the alarm or failure condition.

Running in Trim Mode

When the **TRIM** command is sent from the master sequencer the CCS receives the System Control Parameter, System Control Setpoint, and the sequencer load and unload deadband and bandwidth parameters. These new control parameters are used instead of those defined on the CCS itself. The compressor's local long-pulse, short-pulse, and update time are used for slide valve movement.

The main status page will identify the control setpoint group as SY indicating that it is the System Control Setpoint. Automatic Capacity Control is used to adjust the slide valve while in Sequenced mode. The System Control Parameter, System Control setpoints, and Low Alarm and Failure setpoints are sent to the compressor periodically by the master sequencer to ensure that the compressor is always using current data. All automatic Starting and Stopping of the screw compressor is controlled by the master sequencer. The local screw's Cut-In and Cut-Out controls are also disabled. When

the screw compressor is fully loaded, limited, or forced to unload due to high Motor Current, the CCS informs the master sequencer that no further capacity increases are possible and additional compressors may be needed.

Running in Full Load Mode

When the **FULL LOAD** command is received the CCS disables all capacity control and locks the slide valve at the fully loaded position. However, normal limiting and unloading functions will still be active.

Anti-Cycle in Sequenced Mode

While in the **SEQUENCED** mode the anti-cycle time takes on a new role. If the master sequencer requests a screw compressor to stop but time is still remaining on the anti-cycle timer, the compressor will not stop. The compressor will remain running, at its minimum slide valve position, until the anti-cycle timer expires. This procedure ensures that the compressor is always available for the next sequenced start. If the compressor should be stopped manually, or due to a failure, with time remaining on the anti-cycle timer it would then be unavailable for sequencing until the timer expires.

Forced Unloading & Limiting

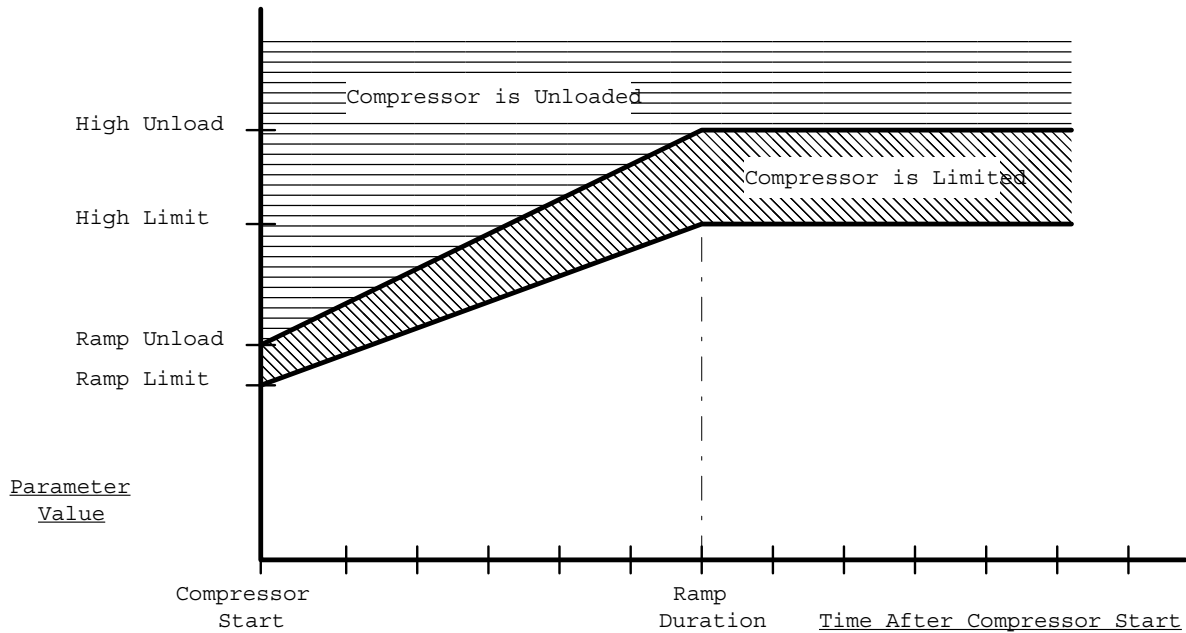
FORCED UNLOADING AND LIMITING are performed to protect the system under extreme conditions or to slow-down the rate of capacity increase. The **CCS** may unload the compressor or limit loading of the compressor due to high motor current or high discharge pressure. In the Manual mode of operation, only high motor current limiting and forced unloading is enabled. Forced unloading and limiting will cancel any ongoing capacity control movements of the slide valve. If a parameter exceeds the high limit setpoint the compressor will be limited (not allowed to load). If a parameter exceeds the high unload setpoint the compressor will be forced to unload until the parameter is reduced.

Ramp Start

RAMP START adjusts the forced unloading and limiting setpoints during a period of time after the compressor is started. Ramp start is used to reduce the demand power requirements during compressor startup. Each high unload and high limit setpoint has associated with it a similar ramp unload and ramp limit setpoint. Also associated with each different parameter is a ramp duration time. After the compressor has started, the forced unloading and limiting setpoints are gradually changed from the ramp setpoints to the high setpoints during the ramp duration time. The Discharge Pressure Ramp Start parameters are setup on the Discharge Pressure Setpoints screen under the **SETPT** hot key. The Motor Current Ramp Start parameters are setup on the Motor Current Setpoints screen under the **SETPT** hot key.

The relationship of the ramp start feature to unloading and limiting can be seen in the following figure.





Ramp Figure

Slide Valve Position Ramp Start Limiting

The **SLIDE VALVE POSITION RAMP START** feature has been provided to limit capacity increases after the compressor starts. The operator can define the minimum positions to start ramping, the total time to limit capacity increases and the maximum position. Once the compressor is started the capacity ramp timer is started, and the capacity will be allowed to increase to the minimum position as soon as required. Once at the minimum, capacity increases will be limited. The maximum allowable position of the slide valve will be gradually increased from the minimum position to the maximum position over the ramp duration. When the capacity is limited due to this feature, the screw state will display "**LIMIT:SV**". Unlike other limiting and unloading, the compressor is not considered fully loaded when in this state. This feature is available in Automatic, Auto-Remote and Sequenced mode. When in sequenced mode, the capacity ramp is also used to limit movement of the slide valve when the compressor is a fully loaded machine. If a fully loaded compressor is forced to unload for any reason, the capacity ramp will engage from the current slide valve position once capacity control resumes. The capacity ramp start parameters are set-up on the slide valve position setpoint screen.

NOTE: This feature is only available if a slide valve indicator is present.

Setpoint Scheduling

SETPOINT SCHEDULING is the automatic switching of Suction Pressure or Process Temperature control setpoint groups based on time of the day and day of the week. The operator can define up to seven (7) different daily time schedules and one weekly schedule. Schedule events can be manually overridden and scheduling can be enabled or disabled by the operator. Setup of schedules and control of the scheduling is performed under the **SETPT** hot key.

Daily Schedules

Each **DAILY SCHEDULE** consists of up to eight (8) different time-of-day slots. For each time-of-day slot the operator can define the time (either in 12 or 24 hour mode, depending on system clock mode selected) and the desired setpoint group number. Unused time slots are ignored and the schedule may be entered in any order. When the schedule is saved it is reordered chronologically. Each daily schedule is identified by a schedule name (SCH1 - SCH7).

Weekly Schedule

The **WEEKLY SCHEDULE** allows the operator to assign different daily schedules to each day of the week. A new day begins and schedules change at midnight. The current daily schedule or control group may be overridden by the operator at anytime. Any item which has been manually overridden will be changed when the next schedule change occurs.

Oil Temperature Regulation

The **OIL TEMPERATURE** in the oil separator is regulated when the screw compressor is stopped. The temperature is maintained above the oil heater setpoint with a deadband of +5 degrees. When the compressor is stopped and the Oil Sump Temperature falls below the Heater Control setpoint, the oil heaters will be turned on. When the Oil Sump Temperature rises 5 degrees above the Heater Control setpoint, the oil heaters will be turned off. The Heater Control setpoint may be found on the Oil Temperature Setpoints screen under the **SETPT** hot key.

Liquid Injection

The **LIQUID INJECTION** on the Sullair compressor is controlled based on the state of the compressor and the discharge temperature. The liquid injection solenoid is closed whenever the motor is off. When the motor is running, the solenoid is open and closed based on discharge temperature. When the discharge temperature is above a user defined LIQ INJ CUT-IN setpoint the solenoid is opened. When the discharge temperature falls below a user defined LIQ INJ CUT OUT setpoint, the solenoid will be closed.



Anti-Cycle Timer

The **ANTI-CYCLE TIMER** is used to avoid repeated start attempts within a 20 minute period of time. The Anti-Cycle timer is started with the motor and must completely count down before the motor can be started again. The time period is not adjustable by the operator.

Power Fail Restart

The operator can define a **POWER FAIL RESTART** time from the miscellaneous time setpoint screen. If the **CCS** is reset manually or due to a loss of power the down time is calculated and compared to this setpoint. If power was off longer than the power fail restart time a failure is reported. If the power loss was less then the setpoint no failure is reported and the compressor remains on-line and is allowed to automatically restart if required.

Remote Status Information

The Remote option provides for a group of discrete outputs for **REMOTE STATUS INFORMATION**. The list of Remote status outputs is as follows.

REMOTE STATUS OUTPUT	DESCRIPTION
LIMITED ANTI-CYCLE	A high signal indicates the screw compressor cannot be started due to the anti-cycle timer.
LOAD LIMITED	A high signal indicates the screw compressor is currently limited or being forced to unload due to high motor current, high discharge pressure, or capacity ramp.
MINIMAL LOAD	A high signal indicates the slide valve is above the minimal load position.
INTERMEDIATE LOAD	A high signal indicates the slide valve is above the intermediate load position.
FULL LOAD	A high signal indicates the slide valve is fully loaded.
ALARM	A high signal indicates an alarm is active.
FAIL	A high signal indicates a failure is active.
ON-LINE	A high signal indicates the screw compressor is on-line for remote operations.

The minimal and intermediate load positions can be defined using the Remote Slide Valve Setup screen from the Configuration menu. This allows the operator to adjust the remote slide valve outputs to the needs of the facility.

Process Temperature Control (Option)

When the **PROCESS TEMPERATURE CONTROL** option is enabled, the screw compressor slide valve position is adjusted to maintain the outlet temperature of a product or process instead of suction pressure (e.g. chiller outlet temperature control). The control strategy is documented in the Capacity Control section above.

Starting By-Pass Solenoid (Option)

The control of a **STARTING BY-PASS SOLENOID** is an optional feature to allow the discharge pressure port of the compressor to be bypassed to the suction port for an adjustable time period after the compressor first starts up. This option is generally used to reduce the starting torque on the motor.



Operational Procedures


The operator interface for the screw compressor is performed using LCD, keypad, and the following nine hot keys:

- START
- STATS
- MODE
- SETPT
- SCHED
- CNTRL
- MISC
- LOGS
- MENUS

The following sections will explain the operating procedures associated with each of these hot keys. If additional plant control functions are present in the controller, some or all of the above functions may be listed under a separate hot key called SCREW. Additional hot keys that may be present on a system will be discussed in separate documents.

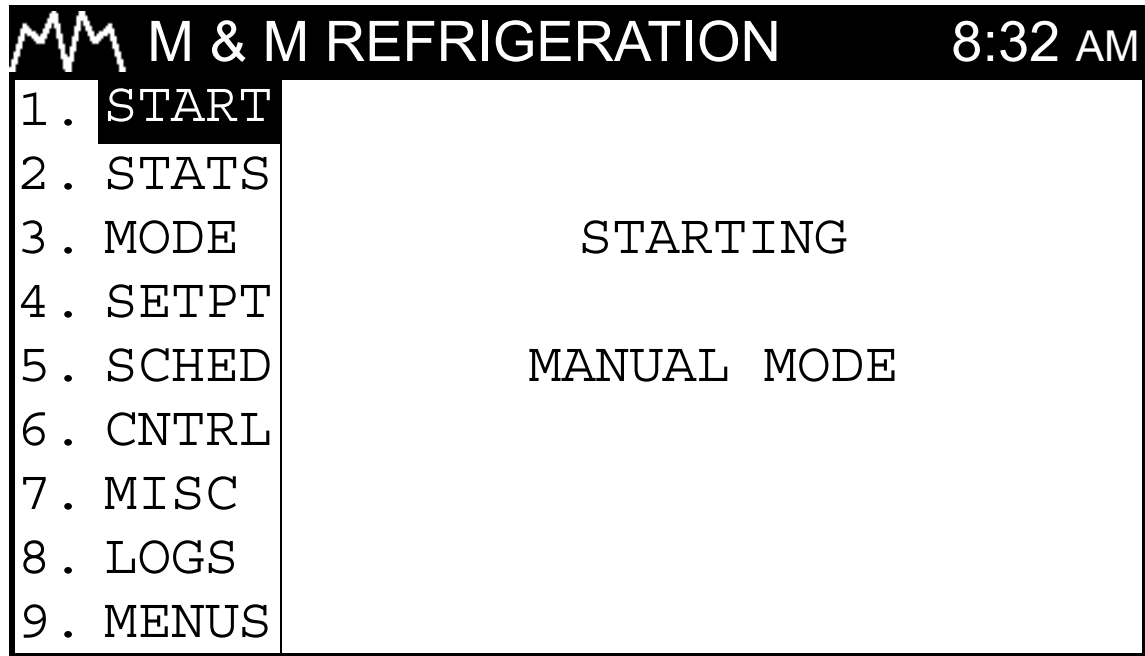
START Hot Key

The **START** hot key begins the compressor start sequence for the modes which require starting from the keypad. The other operational modes will require the use of the **START** hot key to put the compressor on-line. A confirmation screen appears after the **START** hot key option is selected to verify the action.

 M & M REFRIGERATION		8:32 AM
1 . START	<p>VERIFY START COMPRESSOR</p> <p>1 . NO 2 . YES</p>	
2 . STATS		
3 . MODE		
4 . SETPT		
5 . SCHED		
6 . CNTRL		
7 . MISC		
8 . LOGS		
9 . MENUS		

Start Confirmation Screen

The following screen is an example of one of the possible momentary screens that may appear after answering yes to the Start Confirmation screen. The possible momentary screens will vary depending on the individual system configuration.



Start Momentary Screen

The following table lists possible momentary screens associated with the **START** hot key.

SCREEN	FUNCTION
STARTING LOCAL MODE	The compressor is starting in the Local mode.
STARTING MANUAL MODE	The compressor is starting in the Manual mode.
STARTING AUTOMATIC MODE	The compressor is starting in the Automatic mode.
ON-LINE REMOTE MODE	The compressor is on-line in the Remote mode and may start, depending on the state of the Remote Start/Stop input.
ON-LINE AUTO-REMOTE MODE	The compressor is on-line in the Auto-Remote mode and may start, depending on the state of the Remote Start/Stop input.
ON-LINE SEQUENCED MODE	The compressor is on-line in the Sequenced mode and may start, depending on the master sequencer.
START DISABLED ALREADY IN PROGRESS	The start function is disabled because the compressor is already in the process of undergoing the start-up operation.
START DISABLED SYSTEM IS RUNNING	The start function is disabled because the compressor is already running.
START DISABLED ANTI-CYCLE XX:XX	The compressor is delayed from starting. An anti-cycle timer has been activated which prevents start-up until the 20 minute time period has expired (XX:XX is the time remaining). The screen will continue to be displayed until the timer expires or the user presses the QUIT key.
START DISABLED SYSTEM ALARM/FAILURE	The start function is disabled due to a system alarm or failure.



STATS Hot Key

The **STATS** hot key will allow the user to return quickly to the main status screen. The operator may select the Compressor Status screen or the Compressor Graphics screen as the default main status screen. The **QUIT** key will always return the user to the currently selected main status screen. Subsequent uses of the **QUIT** key will toggle between the compressor status screen and the compressor graphics screen.

Compressor Main Status Screen

The **COMPRESSOR STATUS SCREEN** shows a numerical summary of the compressor analog and state parameters. The values are continuously updated in real-time to reflect the current state of the compressor. For example, in the figure below the current state of the system is RUN-TRIM. The system's mode of operation is SEQ (Sequenced) and the alarm status of the system is NORM (normal). There are also two system functions which may be performed from this screen: Slide valve adjustment when in Manual or Local modes and the clearing of alarms and failures.

M & M REFRIGERATION				8:32 AM	
1 . START	SY	XXX.X	PSIG	MA	XXX.X AMPS
2 . STATS	SP	XXX.X	PSIG	ST	XXX.X DEGF
3 . MODE	DP	XXX.X	PSIG	DT	XXX.X DEGF
4 . SETPT	OP	XXX.X	PSIG	OT	XXX.X DEGF
5 . SCHED	OF	XXX.X	PSIG	OS	XXX.X DEGF
6 . CNTRL				PT	XXX.X DEGF
7 . MISC	SV	XX	PCT		
8 . LOGS					
9 . MENUS		RUN-TRIM		SEQ	NORM

Screw Status Screen with Slide Valve Indicator

M & M REFRIGERATION				8:32 AM	
1. START	SY	XXX.X	PSIG	MA	XXX.X AMPS
2. STATS	SP	XXX.X	PSIG	ST	XXX.X DEGF
3. MODE	DP	XXX.X	PSIG	DT	XXX.X DEGF
4. SETPT	OP	XXX.X	PSIG	OT	XXX.X DEGF
5. SCHED	OF	XXX.X	PSIG	OS	XXX.X DEGF
6. CNTRL					
7. MISC				SV	MIN POSITION
8. LOGS					
9. MENUS		RUN-TRIM		SEQ	NORM

Screw Status Screen without Slide Valve Indicator

The following table lists the additional keys available on the screw main status screen.

KEY	FUNCTION
UP ARROW	Loads the compressor when screw is in Manual or Local mode.
DOWN ARROW	Unloads the compressor when screw is in Manual or Local mode.
CLEAR	Stops manual capacity loading or unloading. Acknowledges alarms and failures and stops the alarm horn from sounding.

Screw Status Screen Keys



Manual control of the slide valve is discussed in the Capacity Control section and alarms and failures are discussed in the Alarm/Failure section of this manual.

The following table lists the various parameters displayed on the screw status screen.

PARAMETER	DESCRIPTION
S1-S4, P1-P4, SY	The active capacity control setpoint. S1-S4 indicate represent Suction Pressure setpoints, P1-P4 represent Process Temperature setpoints, and SY represents the Sequenced setpoint.
SP	Suction Pressure
DP	Discharge Pressure
OP	Oil Pressure
OF	Oil Filter Differential Pressure
SV	Displayed as either a percentage if a Slide Valve Indicator is used, or "Min Position", "Partial Load", or "Full Load"
MA	Motor Current
ST	Suction Temperature
DT	Discharge Temperature
OT	Oil Temperature
OS	Oil Sump Temperature
PT	Process Temperature (Option)

NOTE: The Oil Pressure and Oil Filter Pressure values are computed values based on various raw sensor values, depending on the compressor.

Status Banner

The **STATUS BANNER** is located at the bottom of the Compressor Status screen, Compressor Graphics screen, Active Alarms & Failures screen, and Auto-Start Warning status screen. The Banner consists of three highlighted sections which provide the user with the status of the following system conditions.

- Current System State
- Current Operating Mode
- Alarm & Failure Status

System Current State

The left-most highlighted status banner section displays the current state of the system. The following is a table with a brief description of possible system states.

CURRENT STATE	DESCRIPTION
ACYCLE	Anti-cycle count down timer has been activated to delay motor start.
STOPPED	Compressor is stopped.
STARTING	Starting sequence is in progress.
RUNNING	Compressor is running.
LOADING	Slide valve and capacity is increasing.
UNLOADING	Slide valve and capacity is decreasing.
MA LIMIT	Loading was stopped due to high motor current.
SV LIMIT	Loading was stopped due to slide valve position.
DP LIMIT	Loading was stopped due to high discharge pressure.
MA UNLOAD	Forced unloading due to high motor amps.
DP UNLOAD	Forced unloading due to high discharge pressure.
STOPPING	Stopping sequence is in progress.
FAILED	Compressor has failed.
RESET	The CCS has been reset.
Vi ADJUST	Indicates that the Vi is being adjusted (Option)
STOP-OFFLINE	Compressor is stopped and is off-line (not available for auto start).
STOP-ONLINE	Compressor is stopped and is on-line (available for auto start)
STOP CUT-OUT	Compressor is stopped on cut-out pressure (or temperature)
RUN-TRIM	The compressor is running in Sequenced mode as the Trim machine.
FULL-LOAD	The compressor is running in Sequenced mode as a Fully Loaded machine.

System State

Mode Area

The middle highlighted status banner section displays the general operating **MODE** of the system as shown in the following table:

MODE	DESCRIPTION
AUTO	Automatic mode is selected.
MAN	Manual mode is selected.
RMT	Remote mode is selected.
ARMT	Auto-Remote mode is selected.
LOCAL	Local mode is selected.
SEQ	Sequenced mode is selected.

System Modes



Alarm & Failure Area

The right most highlighted status banner section displays the **ALARM AND FAILURE STATUS** of the system. When a new alarm or failure occurs, this area will flash from highlighted to non-highlighted to inform the operator. The area will stop flashing but remain highlighted when the operator has used the **CLEAR** key to acknowledge the alarm or failure. Once all alarm and failure conditions have been corrected the operator may again press the **CLEAR** key to clear the alarm from the display. The following table lists the various alarm/failure states and their meanings.

✍ **NOTE:** *If both an alarm and failure exist the failure state will be displayed as it has a higher priority.*

ALARM MESSAGE	SYSTEMS STATUS
NORM	No alarm or failure is active, the screw is operating normally.
ALARM	An alarm is active on the screw.
FAIL	A failure is active on the screw.

Alarm Status

Compressor Graphics Screen

The **COMPRESSOR GRAPHICS** screen shows all of the same information as the Compressor Status screen, but in a graphical format. Animation of the compressor and oil pump (if supplied) are used whenever the compressor is running so that the user may quickly evaluate the condition of the compressor.

Energy Status Screen

The **ENERGY STATUS** screen displays the Motor Current and the computed energy consumption information.

M & M REFRIGERATION		8:32 AM
1 . START	ENERGY STATUS	
2 . STATS		
3 . MODE	MOTOR CURRENT	XXXX.X AMPS
4 . SETPT		
5 . SCHED	PRESENT KW	XXXX.X KW
6 . CNTRL	DEMAND KW	XXXX.X KW
7 . MISC		
8 . LOGS	KWH TODAY	XXXX.X KWH
9 . MENUS	KWH YESTERDAY	XXXX.X KWH

Energy Status Screen

The following table lists the various parameters displayed on the screen.

TERM	DEFINITION
MOTOR CURRENT	The compressor Motor Current value.
PRESENT KW	The current compressor electrical consumption.
DEMAND KW	The calculated average electrical demand over the last 15 minutes (sliding time window) for the compressor.
KWH TODAY	The total electric energy consumed since 12 o'clock midnight by the compressor.
KWH YESTERDAY	The total electric energy consumed by the compressor on the previous day.

Energy Status Definitions



Operating Hours Screen

The **OPERATING HOURS STATUS** screen allows the operator to view the compressor's current running hours since its last start and the total number of hours the system has been in operation since installation. In addition, the number of compressor starts is accumulated for today, yesterday, and the overall total.

M & M REFRIGERATION		8:32 AM
1 . START	OPERATING STATUS	
2 . STATS		
3 . MODE	RUNNING HRS	XXX.X HRS
4 . SETPT	TOTAL HRS	XXX.X HRS
5 . SCHED		
6 . CNTRL		
7 . MISC	STARTS TODAY	XX
8 . LOGS	STARTS YESTERDAY	XX
9 . MENUS	STARTS TOTAL	XXX

Operating Hours Status Screen

The following table lists the various parameters displayed on the screen.

TERM	DEFINITION
RUNNING HOURS	The number of successive motor running hours since the last start up.
TOTAL HRS	The motor's total accumulated running hours.
STARTS TODAY	The number of times the motor has been started since midnight.
STARTS YESTERDAY	The number of times the motor was started yesterday.
STARTS TOTAL	The total number of times the motor has been started.

Operating Hours Status Definitions

Active Alarms & Failures Status Screen

The **ACTIVE ALARMS & FAILURES STATUS** screen displays the system's current Alarms/Failures. This screen will be the initial screen displayed by the system when an alarm or failure first becomes active. The default status screen can be reached by simply pressing the **QUIT** key. An example of the alarm screen is shown below.

M & M REFRIGERATION			8:32 AM	
1. START	ACTIVE ALARMS & FAILURES			
2. STATS	HH:MM:SS	TYPE	DESCRIPTION	STATE
3. MODE	HH:MM:SS	TYPE	DESCRIPTION	STATE
4. SETPT				
5. SCHED				
6. CNTRL				
7. MISC				
8. LOGS				
9. MENUS	RUN-TRIM	SEQ	NORM	

Active Alarms & Failures Status Screen

The active function keys for this screen are described in the following table.


KEY	FUNCTION
SHIFT	Switches control between the display area and the hot keys.
UP/DOWN ARROWS	Scrolls line by line through the information.
CLEAR	The CLEAR key is used to acknowledge and clear alarms/failures as well as to silence the alarm horn.

Active Alarms & Failure Status Definitions



Auto-Start Warning Screen

The **AUTO-START WARNING** screen is displayed anytime the screw may be automatically started. The user can return to the system default status screen by pressing the **QUIT** key or cycle through all the status screens using the **ENTER** key. The system will return to the Auto-Start Warning screen after 10 minutes of keypad inactivity. An example of the screen is shown below.

M & M REFRIGERATION8:32 AM

1 . START

2 . **STATS**

3 . MODE

4 . SETPT

5 . SCHED

6 . CNTRL

7 . MISC

8 . LOGS

9 . MENUS

** CAUTION **

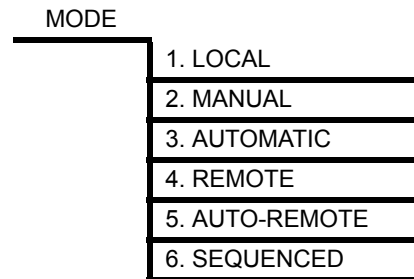
SCREW MAY START ANYTIME

RUN-TRIM SEQ NORM

AUTO Start Warning Screen

MODE Hot Key

The **MODE** hot key allows the operator to select the system's operational mode. When the **MODE** hot key is selected, a menu screen displays the available modes contained on the system. This menu screen could have up to six mode options: Manual, Automatic, Remote, Auto-Remote, Sequenced, and Local. The mode set by the user will correspond to the mode visible in the mode area of the status banner. The following menu diagram represents the modes available on a standard screw.



Mode Menu Diagram

After making a selection from the operating mode menu, a momentary screen will appear to verify the selection. The message will vary depending on which mode was selected as shown in the following table.

Local Mode

LOCAL mode is used to allow service personnel to operate or lock-out the equipment without interference from other users at remote locations. Once the mode is changed to Local at the panel, other operators cannot change the mode or start and stop the compressor. Compressor operation in Local mode is the same as Manual mode.

Manual Mode

MANUAL mode is used primarily for startup and diagnostic purposes by operators at the plant. Starting, stopping, loading and unloading are generally performed through the keypad.

Automatic Mode

AUTOMATIC mode is the primary operational configuration for stand-alone compressors. The capacity of the machine is automatically adjusted to achieve the control setpoint. The control setpoint can be manually adjusted or scheduled by time-of-day and day-of-week. The compressor may also be started and stopped automatically using cut-in and cut-out setpoints.

Remote Mode

The **REMOTE** mode is only available if the Remote option is enabled. It is primarily used for systems where another control system is responsible for starting, stopping, and capacity control. Remote mode uses an external Remote Start/Stop input and Remote Load and Unload inputs for capacity control. A set of discrete outputs are available for remote status information.

Auto-Remote Mode

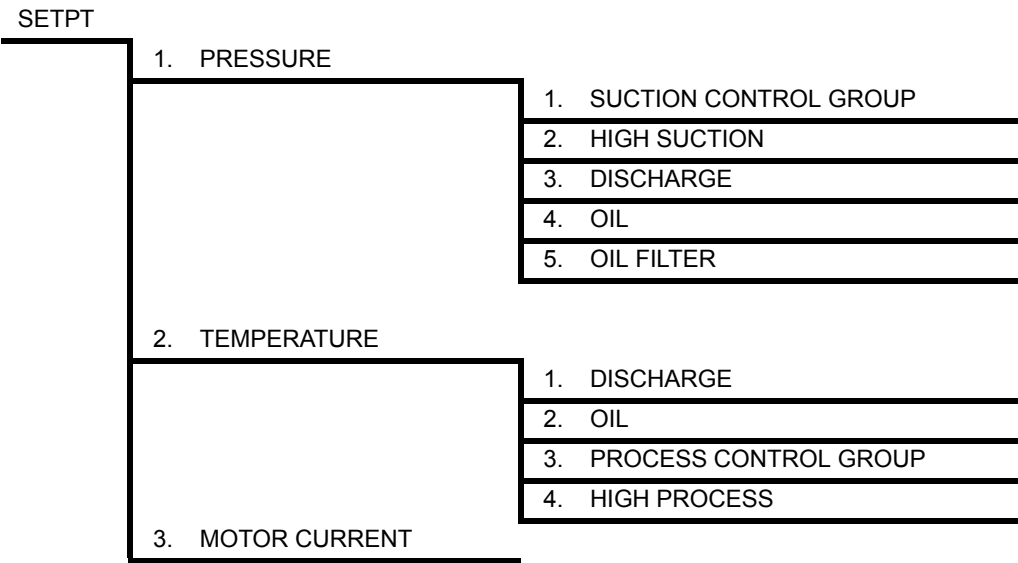
The **AUTO-REMOTE** mode is only available if the Auto-Remote option is enabled. It is primarily used for systems where another control system is responsible for starting and stopping the compressor but cannot directly perform capacity control. Auto-Remote mode uses the external Remote Start/Stop input and Remote Setpoint selection inputs for capacity control.

Sequenced Mode

The **SEQUENCED** mode is only available if the Sequenced option is enabled. It is used in M&M control systems where a master sequencer controller is responsible for starting and stopping multiple compressors in a system. Capacity control in Sequenced mode is performed by the compressor based on setpoints and control parameters sent by the master sequencer.

SETPT Hot Key

The **SETPT** hot key allows the user to access a set of menu options used to set the systems various setpoints.



SETPT Menu Diagram

Pressure Setpoints

The **PRESSURE SETPOINTS** menu allows the user adjust the various pressure related setpoints described in the following sections.

Suction Pressure Control Groups

This screen allows the user to set the control values for each of the screws four control groups which are used for Automatic Capacity control. An example of the screen is shown below.

SUCTION PRESSURE day mm/dd/yy hh:mm:ss				
CONTROL GROUP				
ACTIVE GROUP S1				
	GROUP S1	GROUP S2	GROUP S3	GROUP S4
CUT-IN	XX.X PSIG	XX.X PSIG	XX.X PSIG	XX.X PSIG
CONTROL	XX.X PSIG	XX.X PSIG	XX.X PSIG	XX.X PSIG
CUT-OUT	XX.X INHG	XX.X INHG	XX.X INHG	XX.X INHG
LOW ALARM	XX.X INHG	XX.X INHG	XX.X INHG	XX.X INHG
LOW FAILURE	XX.X INHG	XX.X INHG	XX.X INHG	XX.X INHG

Suction Pressure Control Data Entry Screen

The following table lists the data entry fields on the screen and a description of their purposes.

TERM	DEFINITION	RANGE
ACTIVE GROUP	There are four possible suction pressure control groups, each with its own pressure parameters.	S1 - S4
CUT-IN	Cut-in Setpoint. If Automatic or Auto-Remote mode is selected, Auto Start/Stop is enabled, the compressor is on-line, and the suction pressure rises above the Cut-in Setpoint, the compressor will start.	29.9 INHG - 185.0 PSIG
CONTROL	Control Setpoint. In the Automatic or Auto-Remote mode of operation the compressor is loaded or unloaded as required to maintain the Control Setpoint.	29.9 INHG - 185.0 PSIG
CUT-OUT	Cut-out Setpoint. If Automatic or Auto-Remote mode is selected, Auto Start/Stop is enabled, the compressor is on-line, and the suction pressure falls below the Cut-out Setpoint, the compressor will stop.	29.9 INHG - 185.0 PSIG
LOW ALARM	The suction pressure value at which the CCS should report a Low Suction Pressure alarm to the operator (for all modes except Sequenced).	29.9 INHG - 185.0 PSIG
LOW FAILURE	The suction pressure value at which the CCS should fail (stop) the compressor and report a failure to the operator (for all modes except Sequenced).	29.9 INHG - 185.0 PSIG

Suction Pressure Control Data Definitions



High Suction Pressure Setpoints

The **HIGH SUCTION PRESSURE** alarm and failure setpoints are not scheduled and are active regardless of which group is in control.

M & M REFRIGERATION		8:32 AM
1. START	HIGH SUCT SETPTS	
2. STATS		
3. MODE	HIGH FAILURE	XXX.X PSIG
4. SETPT	HIGH ALARM	XXX.X PSIG
5. SCHED		
6. CNTRL		
7. MISC		
8. LOGS		
9. MENUS		

High Suction Pressure Setpoints Screen

The following table lists the data entry fields for the High Suction Pressure Setpoints screen.

TERM	DEFINITION	RANGE
HIGH FAILURE	The compressor is failed (stopped) when this value is exceeded.	29.9 INHG - 185 PSIG
HIGH ALARM	The CCS reports an alarm to the operator when this value is exceeded.	29.9 INHG - 185 PSIG

High Suction Pressure Data Definitions

Discharge Pressure Setpoints

The **DISCHARGE PRESSURE SETPOINTS** screen is used to set the discharge pressure control parameters for high alarm, limiting, and ramp conditions.

DISCHARGE PRESSURE day mm/dd/yy hh:mm:ss SETPOINTS		
HIGH FAILURE	XXX.X	PSIG
HIGH ALARM	XXX.X	PSIG
HIGH UNLOAD	XXX.X	PSIG
HIGH LIMITING	XXX.X	PSIG
RAMP UNLOAD	XXX.X	PSIG
RAMP LIMITING	XXX.X	PSIG
RAMP START DELAY	XXX.X	MIN
RAMP START ENABLE	DISABLE	

Discharge Pressure Setpoints Data Entry Screen

The following table lists the data entry fields for the Discharge Pressure Setpoints screen.

TERM	DEFINITION	RANGE
HIGH FAILURE	The compressor is failed (stopped) when this value is exceeded.	0 - 225 NH ₃ 0 - 275 FREON
HIGH ALARM	The CCS reports an alarm to the operator when this value is exceeded.	0 - 225 NH ₃ 0 - 275 FREON
HIGH UNLOAD	The compressor is forced to unload when this value is exceeded.	0 - 225 NH ₃ 0 - 275 FREON
HIGH LIMITING	The compressor is not allowed to load when this value is exceeded.	0 - 225 NH ₃ 0 - 275 FREON
RAMP UNLOAD	The starting value of the forced unload parameter used during ramp start.	0 - 225 NH ₃ 0 - 275 FREON
RAMP LIMITING	The starting value of the limiting parameter used during ramp start.	0 - 225 NH ₃ 0 - 275 FREON
RAMP START DELAY	The time period after start used to ramp the forced unload and limiting parameters from the ramp value to the normal value.	0.1 - 60 Min
RAMP START ENABLE	Allows Discharge Pressure Ramp start to be enabled or disabled.	ENABLE/ DISABLE

Discharge Pressure Data Definitions



Oil Pressure Setpoints

The **OIL PRESSURE SETPOINTS** screen allows the operator to set acceptable ranges for the oil pressure parameter to allow the **CCS** to identify when the value is out of range. An example of the screen is shown below.

M & M REFRIGERATION		8:32 AM
1. START	OIL PRESS SETPTS	
2. STATS		
3. MODE	HIGH FAILURE	XXX.X PSIG
4. SETPT	HIGH ALARM	XXX.X PSIG
5. SCHED		
6. CNTRL	LOW ALARM	XXX.X PSIG
7. MISC	LOW FAILURE	XXX.X PSIG
8. LOGS		
9. MENUS		

Oil Pressure Setpoints Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
HIGH FAILURE	The compressor will be failed (stopped) when the Oil Pressure is above this value.	20 - 200 PSIG
HIGH ALARM	The CCS will report an alarm to the operator when the Oil Pressure is above this value.	20 - 200 PSIG
LOW ALARM	The CCS will report an alarm to the operator when the Oil Pressure is below this value.	20 - 200 PSIG
LOW FAILURE	The compressor will be failed (stopped) when the Oil Pressure is below this value.	20 - 200 PSIG

Oil Pressure Data Definitions

NOTE: The displayed oil pressure is a computed value. The computation of this value is different based on the compressor model. (see section on **Oil Pressure Calculations** for more detail.)

Oil Filter Pressure Setpoints

The **OIL FILTER SETPOINTS** screen allows the operator to set an acceptable range for the oil filter pressure as shown in the following example.

NOTE: The displayed oil pressure is a computed value. The computation of this value is different based on the compressor model. (see section on **Oil Pressure Calculations** for more detail.)

M & M REFRIGERATION
8:32 AM

1. START

2. STATS

3. MODE

4. SETPT

5. SCHED

6. CNTRL

7. MISC

8. LOGS

9. MENUS

OIL FLTR PRESS SETPTS

HIGH ALARM
XXX.X PSID

Oil Filter Pressure Setpoints Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
HIGH ALARM	The CCS reports an alarm to the operator when the Oil Filter Differential Pressure exceeds this value.	0 - 25

Oil Filter Pressure Setpoint Definitions

Temperature Setpoints

The **TEMPERATURE SETPOINTS** menu allows the user to set temperature related setpoints described in the following sections.

Discharge Temperature Setpoints

The **DISCHARGE TEMPERATURE SETPOINTS** screen allows the operator to set acceptable ranges for the screw discharge temperature.

M & M REFRIGERATION		8:32 AM
1. START	DISCHARGE TEMP SETPTS	
2. STATS		
3. MODE	HIGH FAILURE	XXX.X DEGF
4. SETPT	HIGH ALARM	XXX.X DEGF
5. SCHED		
6. CNTRL	LIQ INJ CUT-IN	XXX.X DEGF
7. MISC	LIQ INJ CUT-OUT	XXX.X DEGF
8. LOGS		
9. MENUS		

Discharge Temperature Setpoints Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
HIGH FAILURE	The compressor is failed (stopped) when the discharge temperature exceeds this value.	32 - 212
HIGH ALARM	The CCS reports an alarm to the operator when the discharge temperature exceeds this value.	32 - 212
LIQ INJ CUT-IN	The liquid injection solenoid will be open when the discharge temperature is above the value displayed.	32 - 212
LIQ INJ CUT-OUT	The liquid injection solenoid will be closed when the discharge temperature is below the value displayed.	32 - 212

Discharge Temperature Definitions

Oil Temperature Setpoints

The **OIL TEMPERATURE SETPOINTS** screen allows the operator to set acceptable ranges for the screw oil temperature and oil sump temperature regulation.

M & M REFRIGERATION		8:32 AM
1. START	OIL TEMP SETPTS	
2. STATS		
3. MODE	HIGH FAILURE	XXX.X DEGF
4. SETPT	HIGH ALARM	XXX.X DEGF
5. SCHED	HEATER CONTROL	XXX.X DEGF
6. CNTRL	LOW ALARM	XXX.X DEGF
7. MISC	LOW FAILURE	XXX.X DEGF
8. LOGS		
9. MENUS		

Oil Temperature Setpoints Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
HIGH FAILURE	The compressor will be failed (stopped) when the oil temperature exceeds this value.	50 - 180
HIGH ALARM	The CCS will report an alarm to the operator when the oil temperature exceeds this value.	50 - 180
HEATER CONTROL	The temperature at which to maintain the oil in the separator. The oil heater uses the Oil Sump Temperature sensor but only when the compressor is stopped.	50 - 150
LOW ALARM	The CCS will report an alarm to the operator when the Oil Sump Temperature is below this value.	0 - 180
LOW FAILURE	The compressor will be failed (stopped) when the Oil Sump Temperature is below this value.	0 - 180

Oil Temperature Definitions



Process Temperature Control Group

The **PROCESS TEMPERATURE CONTROL GROUP** screen is used to setup the Process Temperature control parameters when the Process Temperature Control option is enabled.

PROCESS TEMPERATURE day mm/dd/yy hh:mm:ss				
CONTROL GROUP				
ACTIVE GROUP P1				
	GROUP P1	GROUP P2	GROUP P3	GROUP P4
	-----	-----	-----	-----
CUT-IN	XX.X DEGF	XX.X DEGF	XX.X DEGF	XX.X DEGF
CONTROL	XX.X DEGF	XX.X DEGF	XX.X DEGF	XX.X DEGF
CUT-OUT	XX.X DEGF	XX.X DEGF	XX.X DEGF	XX.X DEGF
LOW ALARM	XX.X DEGF	XX.X DEGF	XX.X DEGF	XX.X DEGF
LOW FAILURE	XX.X DEGF	XX.X DEGF	XX.X DEGF	XX.X DEGF

Process Temperature Control Groups

The following table lists the various parameters displayed on the process temperature setpoints screen.

TERM	DEFINITION	RANGE
ACTIVE GROUP	There are four possible Process Temperature control groups, each with its own temperature control parameters.	P1-P4
CUT - IN	In the Automatic mode of operation, the compressor starts when the Process Temperature becomes greater than the cut-in temperature.	-58 : 122 DEGF
CONTROL	In the Automatic mode of operation the compressor loads or unloads as needed to maintain the Process Temperature setpoint.	-58 : 122 DEGF
CUT - OUT	In the Automatic mode of operation, the compressor stops when the Process Temperature falls below the cut-out temperature.	-58 : 122 DEGF
LOW ALARM	An alarm is reported when the Process Temperature falls below the low alarm setpoint.	-58 : 122 DEGF
LOW FAILURE	An failure is reported and the compressor is shutdown when the Process Temperature falls below the low failure setpoint.	-58 : 122 DEGF

Process Temperature Definitions

High Process Temperature Selection

The **HIGH PROCESS TEMPERATURE SETPOINTS** screen is only visible when the Process Temperature Control option is enabled.

M & M REFRIGERATION 8:32 AM		
1. START	PROCESS TEMP SETPTS	
2. STATS		
3. MODE	HIGH FAILURE	XXX.X DEGF
4. SETPT	HIGH ALARM	XXX.X DEGF
5. SCHED		
6. CNTRL		
7. MISC		
8. LOGS		
9. MENUS		

High Process Temperature SETPTS

The following table lists the parameter displayed on the process temperature set-points screen.

TERM	DEFINITION	RANGE
HIGH FAILURE	A failure is reported and the compressor is shutdown when the Process Temperature rises above the High Failure set-point.	-58 : 122 DEGF
HIGH ALARM	An alarm is reported when the Process Temperature rises above the High Alarm setpoint.	-58 : 122 DEGF

High Process Temperature Definitions



Motor Current Setpoints

The **MOTOR CURRENT SETPOINTS** screen is used to set the motor current control parameters for high alarm, limiting, and ramp conditions.

MOTOR CURRENT		day	mm/dd/yy	hh:mm:ss
SETPOINTS				
HIGH FAILURE	XXX.X PSIG			
HIGH ALARM	XXX.X PSIG			
HIGH UNLOAD	XXX.X PSIG			
HIGH LIMITING	XXX.X PSIG			
RAMP UNLOAD	XXX.X PSIG			
RAMP LIMITING	XXX.X PSIG			
RAMP START DELAY	XXX.X MIN			
RAMP START ENABLE	DISABLE			

Motor Current Setpoints Data Entry Screen

The following table lists the data entry fields for the Motor Current Setpoints screen.

TERM	DEFINITION	RANGE
HIGH FAILURE	A failure is reported and the compressor is shutdown when the Motor Current exceeds the High Failure Setpoint.	0 - 2000 AMPS
HIGH ALARM	An alarm is reported when the Motor Current exceeds the High Alarm setpoint.	0 - 2000 AMPS
HIGH UNLOAD	The compressor is forced to unload when this value is exceeded.	0 - 2000 AMPS
HIGH LIMITING	The compressor is not allowed to load when this value is exceeded.	0 - 2000 AMPS
RAMP UNLOAD	The starting value of the forced unload parameter used during ramp start.	0 - 2000 AMPS
RAMP LIMITING	The starting value of the limiting parameter used during ramp start.	0 - 2000 AMPS
RAMP START DELAY	The time delay after the compressor starts where Motor Current ramping occurs.	0 - 60 MIN
RAMP START ENABLE	Allows Motor Current Ramp start to be enabled or disabled.	ENABLE/ DISABLE


Motor Current Data Definitions

Slide Valve Setpoints

The **SLIDE VALVE SETPOINTS** screen allows the operator to set acceptable ranges for the Slide Valve Setpoints as shown in the following example.

SLIDE VALVE POSITION day mm/dd/yy hh:mm:ss	
AUTO CAPACITY MAX POSITION	XXXX.X PCT
AUTO CAPACITY MIN POSTION	XXXX.X PCT
RAMP START MIN POSTION	XXXX.X PCT
RAMP START DELAY	XXXX.X MIN
RAMP START ENABLE	ENABLED
REMOTE MID/HIGH BREAK	XXXX.X PCT
REMOTE LOW/MID BREAK	XXXX.X PCT

Slide Valve Setpoints Screen

 **NOTE:** This screen is only available if the Slide Valve Indicator is present.

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
AUTO CAPACITY MAX POSITION	The maximum allowable Slide Valve Position after the screw has started (Not active in Manual or Local modes)	0-100%
AUTO CAPACITY MIN POSITION	The minimum allowable Slide Valve Position after the screw has started (Not active in Manual or Local modes). The minimum capacity position will only be active if the slide valve has exceeded the minimum position once while the compressor has been running.	0-100%
RAMP START MIN POSITION	The minimum Slide Valve Position before Slide Valve Limiting will take place.	0-100%
RAMP START DELAY	The amount of time after startup that Slide Valve Limiting will take place.	0-60 MIN
RAMP START ENABLE	Allows Slide Valve Ramp Start to be enabled or disabled.	ENABLE/ DISABLE
REMOTE MID/HIGH BREAK	When the Remote mode is enabled, this parameter sets the breakpoint for the Remote Capacity discrete indicator output.	0-100%
REMOTE LOW/MID BREAK	When the Remote mode is enabled, this parameter sets the breakpoint for the Remote Capacity discrete indicator output.	0-100%

Slide Valve Setpoint Definitions




SCHED Hot Key

The **SCHEDULING** function allows the user to create and modify schedules to control the changing of suction pressure setpoints based on the day of the week and time of day. The following sections will describe the various screens associated with this function.

SCHED	
1.	CONTROL
2.	ACTIVE GROUP
3.	ACTIVE SCHEDULE
4.	WEEKLY SCHEDULE
5.	DAILY SCHEDULE

Control

The **CONTROL** screen allows the user to determine if equipment operation will be controlled by predefined schedules. An example of this screen is shown below.

 M & M REFRIGERATION 8:32 AM	
1. START	SCHEDULING CONTROL
2. STATS	
3. MODE	SCHEDULING > DISABLE
4. SETPT	
5. SCHED	
6. CNTRL	
7. MISC	
8. LOGS	
9. MENUS	

Scheduling Control Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
SCHEDULING	Allows the Setpoint Scheduling feature to be enabled or disabled.	ENABLE/ DISABLE

Scheduling Definition



Active Group

The **ACTIVE GROUP** screen allows the user to select the current active group. This setting will be active until a scheduling change or the operator modifies it. An example of the screen is shown below.

Active Group Screen

The following table lists the data entry fields and a description of their purposes.

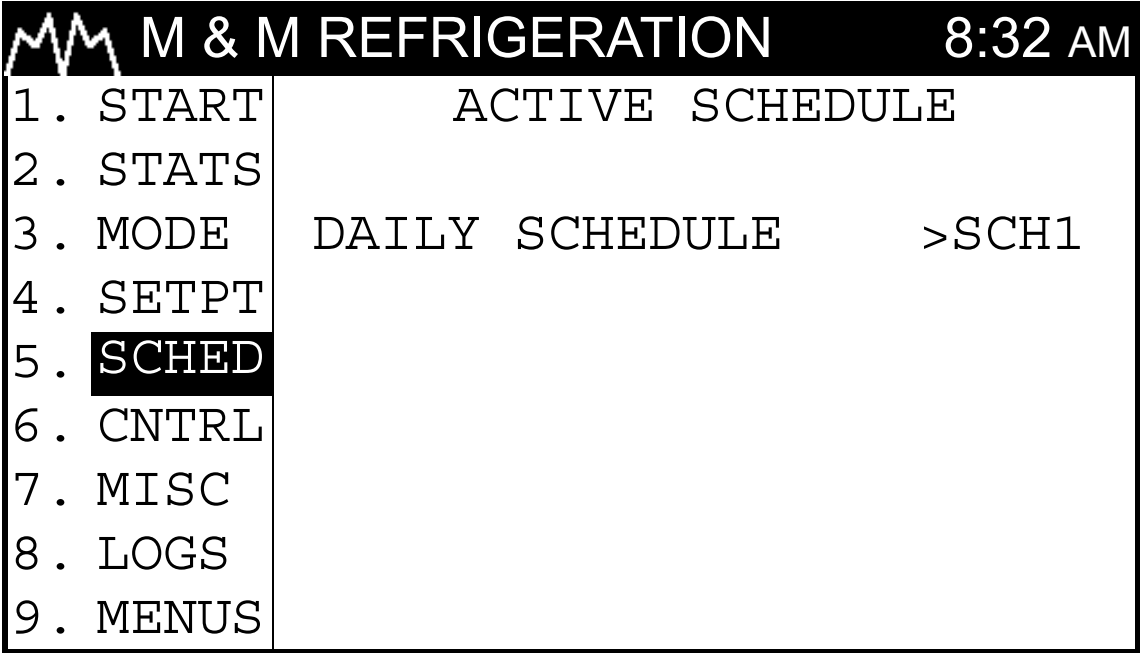
TERM	DEFINITION	RANGE
GROUP NUMBER	The active suction pressure control group for the system. If Suction Pressure control is enabled, G1-G4 correspond to Suction Pressure control groups S1-S4. If Process Temperature control is enabled, G1-G4 correspond to Process Temperature control groups P1-P4.	G1-G4

Active Group Definitions



Active Schedule

The **ACTIVE SCHEDULE** screen allows the user to change the current active daily schedule. This setting will be active until a scheduling change or the user modifies it. An example of the screen is shown below.



Active Schedule Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
DAILY SCHEDULE	The current daily schedule used by the system.	SCH1 - SCH7

Active Schedule Definitions

Weekly Schedule

The **WEEKLY SCHEDULE** screen is used to define which of the seven available daily schedules is to be assigned to each day of the week as shown in the following example screen.

M & M REFRIGERATION 8:32 AM		
1. START	WEEKLY SCHEDULE	
2. STATS		
3. MODE	SUN	SCH2
4. SETPT	MON	SCH1
5. SCHED	TUE	SCH1
6. CNTRL	WED	SCH1
7. MISC	THU	SCH1
8. LOGS	FRI	SCH1
9. MENUS	SAT	SCH2

Weekly Schedule Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
DAYS OF THE WEEK	The daily schedule assigned to that specific day of the week.	SCH1 - SCH7

Weekly Schedule Definitions

Daily Schedules

The **DAILY SCHEDULE** function is used to define the times at which to change control setpoints for each of the seven available daily schedules. The first screen upon entering the Daily Schedule function is an access screen, which prompts the user to enter a number from one to seven to view the corresponding Daily Schedule.



Schedule 1 To Schedule 7

The seven Daily Schedules all have a standard format allowing the user to select up to 8 schedule changes per day. The following example shows the standard format for all seven of the daily schedules.

DAILY SCHEDULE			day	mm/dd/yy	hh:mm:ss
EVENT	SCHEDULED	SELECTED			
NUMBER	TIME	GROUP			
1	XX:XX	G1			
2	XX:XX	G2			
3	XX:XX	G3			
4	XX:XX	G4			
5	XX:XX	G3			
6	XX:XX	G2			
7	XX:XX	G1			
8	XX:XX	G1			

Daily Schedule 1 Screen

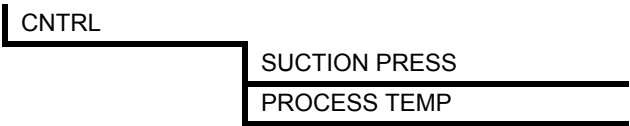
The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
SCHEDULED TIME	The time of day the control group will be changed to the selected group.	Valid Time
SELECTED GROUP	The control group number to be used after the scheduled time occurs.	G1-G4

Daily Schedule 1 Definitions

CNTRL Hot Key

The **CNTRL** hot key allows the user to access a set of menu options used to set the systems control features.



CNTRL Menu Diagram

Suction Pressure Control Setpoints

The **SUCTION PRESSURE CONTROL SETPOINTS** screen allows the user to setup the Load and Unload Controls for Automatic capacity control. The pulse and update time fields are also used for slide valve positioning in the Sequenced mode. Included on this screen is additional reference data to assist the operator when setting-up the compressor. An example of the screen is shown below.

SUCTION PRESSURE CONTROL SETPOINTS					day mm/dd/yy hh:mm:ss			
	LOAD CONTROLS		UNLOAD CONTROLS		REFERENCE DATA			
	-----		-----		-----			
NORMAL BANDWIDTH	XXX.X	PSID	XXX.X	PSID	SETPOINT	S1	XXX.X	PSIG
CONTROL DEADBAND	XXX.X	PSID	XXX.X	PSID				
LONG PULSE	XXX.X	SEC	XXX.X	SEC	SUCTION PRESS		XXX.X	PSIG
SHORT PULSE	XXX.X	SEC	XXX.X	SEC				
UPDATE TIME	XXX.X	SEC	XXX.X	SEC	SV POSITION		XXX.X	PCT
					SV MOVE TIME		XXX.X	SEC
					SCREW MODE		SEQ	
					SCREW STATE		FAILED	

The following table lists the data entry and information fields on the screen and a description of their purposes.

PARAMETER	DEFINITION	RANGE
NORMAL BANDWIDTH	Adjusts the sensitivity of the time proportional control routine.	0 - 20 PSID
CONTROL DEADBAND	The slide valve will not be adjusted if the suction pressure is within the control deadband.	0 - 20 PSID
LONG PULSE	The longest load or unload pulse used to move the slide valve.	0.1 - 60 SEC
SHORT PULSE	The shortest load or unload pulse used to move the slide valve.	0.1 - 60 SEC
UPDATE TIME	The time interval the CCS will wait before it re-calculates the slide valve move time.	0.1 - 60 SEC
SETPOINT	The current control setpoint group and value (reference).	N/A
SUCTION PRESS	The current suction pressure (reference).	N/A
SV POSITION	The current slide valve position (reference).	N/A
SV MOVE TIME	The amount of time the load or unload solenoid will be actuated for the current system parameters (reference).	N/A
SCREW MODE	The current compressor mode (reference).	N/A
SCREW STATE	The current compressor state (reference).	N/A

Suction Pressure Control Setpoints Definitions

Process Temperature Control Setpoints

The **PROCESS TEMPERATURE CONTROL SETPOINTS** screen allows the user to setup the Load and Unload Controls for Automatic capacity control. The pulse and update time fields are also used for slide valve positioning in the Sequenced mode. Included on this screen is additional reference data to assist the operator when setting-up the compresor. An example of the screen is shown below.

PROCESS TEMPERATURE					day mm/dd/yy hh:mm:ss			
CONTROL SETPOINTS								
	LOAD CONTROLS		UNLOAD CONTROLS		REFERENCE DATA			
	-----		-----		-----			
NORMAL BANDWIDTH	XXX.X	DEG	XXX.X	PSID	SETPOINT	S1	XXX.X	PSIG
CONTROL DEADBAND	XXX.X	DEG	XXX.X	PSID				
LONG PULSE	XXX.X	SEC	XXX.X	SEC	PROCESS TEMP		XXX.X	DEGF
SHORT PULSE	XXX.X	SEC	XXX.X	SEC				
UPDATE TIME	XXX.X	SEC	XXX.X	SEC	SV POSITION		MIN POSITION	
					SV MOVE TIME		XXX.X	SEC
					SCREW MODE		AUTO	
					SCREW STATE		ACYCLE	

The following table lists the data entry fields and a description of their purposes.

PARAMETER	DEFINITION	RANGE
NORMAL BANDWIDTH	Adjusts the sensitivity of the time proportional control routine.	0 - 20 DEG
CONTROL DEADBAND	The slide valve will not be adjusted if the Process Temperature is within the control deadband.	0 - 20 DEG
LONG PULSE	The longest load or unload pulse used to move the slide valve.	0.1 - 60 SEC
SHORT PULSE	The shortest load or unload pulse used to move the slide valve.	0.1 - 60 SEC
UPDATE TIME	The time interval the CCS will wait before it re-calculates the slide valve move time.	0.1 - 60 SEC
SETPOINT	The current control setpoint group and value (reference).	N/A
PROCESS TEMP	The current Process Temperature value (reference).	N/A
SV POSITION	The current slide valve position (reference).	N/A
SV MOVE TIME	The amount of time the load or unload solenoid will be actuated for the current system parameters (reference).	N/A
SCREW MODE	The current compressor mode (reference).	N/A
SCREW STATE	The current compressor state (reference).	N/A

Process Temperature Control Setpoints Definitions

MISC Hot Key

The **MISCELLANEOUS CONTROL** screen provides setpoints and controls for various system parameters.

MISCELLANEOUS CONTROL		day mm/dd/yy	hh:mm:ss
AUTO START/STOP	DISABLES		
POWER FAIL RESTART	DISABLES		
POWER FAIL RESTART DELAY	XXX.X MIN		
CAPACITY CONTROL PARAMETER	PRESSURE		
REMOTE SETPT SELECT	DISABLES		
START BYPASS DELAY	XXX.X SEC		

Miscellaneous Control Screen

The following table lists the data entry fields and a description of their purposes.

TERM	DEFINITION	RANGE
AUTO START/STOP	When Auto Start/Stop is Enabled, the compressor will start and stop automatically in the Automatic and Auto-Remote modes.	ENABLE/ DISABLE
POWER FAIL RESART	When Power Fail Restart is Disabled, the compressor will be forced off-line after a power failure occurs. When Enabled, the compressor will be available to auto-restart as long as the power has not been off for longer than the Power Fail Restart Delay.	ENABLE/ DISABLE
POWER FAIL RESTART DELAY	This is the maximum amount of time a compressor is allowed to be without power before being allowed to auto-restart when the power returns.	0 - 999 MIN
CAPACITY CONTROL PARAMETER	When the Process Temperature option is enabled, the Capacity Control parameter allows the user to select between Suction Pressure control and Process Temperature control.	PRESSURE/ TEMPERARUE
REMOTE SETPT SELECT	When the Auto-Remote option is enabled, Remote Setpoint Select enables the use of the external setpoint selection discrete inputs.	ENABLE/ DISABLE
START BYPASS DELAY	When the Starting Bypass option is enabled, this sets the amount of time the Start Bypass Valve will be open after startup.	0.1-60 SEC

Miscellaneous Control Definitions

LOGS Hot Key

The **LOGS** hot key is fully described in Chapter 4, Logging Functions.

MENUS Hot Key

The **MENUS** hot key is fully described in Chapter 5, Menu Functions.



The **Computer Control System (CCS)** records the systems parameters and conditions for later use in a set of logs. Each log has a limit on the number of entries that it can store, so as the log fills-up the oldest entries are replaced by the most recent ones. The system maintains the following standard logs and possibly one or more optional logs. The System Log option requires the M&M Refrigeration, Inc. PC Monitor TM package.

- Operations Log
- Trend Log
- Alarm Log
- Failure Log
- User Log
- KW Log (optional)
- System Log (optional)

Log screens usually contain more data than the LCD display area can show at one time. In order to view the entire set of information the operator uses the function keys. For the specific working procedure of log screens please refer to the log screen section in Chapter 2.



Logging Functions Technical Overview

The following sections will discuss the overall function of each of the five standard logs as well as the optional KW and System Logs.**NETWORK COMMUNICATIONS**

Operations Log

The **OPERATIONS LOG** displays a list of the system operating conditions for the last hour at 30-second intervals and has a limit of 255 recorded data entries. An extra entry is made to the Operations Log when special events occur, such as alarms, failures or system reset. When an alarm, failure, or OEM failure occurs a special indicator is also placed next to the logged parameter causing the problem. Typically the data recorded in this log will be the analog inputs, system state variables and alarm information. However, data recorded in this log will vary depending on the system's configuration.

Trend Log

The format of the **TREND LOG** is identical to the operations log. The Trend Log allows the user to define the recording interval (Default 15 minutes) and has a limit of 255 recorded data entries. A special entry is made to the Trend Log when certain events occur similar to the Operations Log. Indicators and highlighting are used to identify parameters causing alarms or failures as in the Operations Log.

Alarm Log

The **ALARM LOG** is a record of the last 100 system alarms. When an alarm first occurs an alarm entry is made in the log. The process is repeated until the maximum of 100 entries is reached. Alarms previously logged are then replaced by more recent alarms detected.

Failure Log

The **FAILURE LOG** is a record of the last 100 failures. When a failure first occurs a failure entry is made in the log. The process is repeated until the maximum of 100 entries is reached. Failures previously logged are then replaced by more recent failures detected.

User Log

The **USER LOG** is a record of the last 50 users who logged on to the system. An entry is made into this log when a user logs on to the system. The process is repeated until the maximum of 50 entries is reached. Users previously logged on are then replaced by users who have more recently logged on.

KW Log (Optional)

The **KW LOG** is an optional daily log included when the KW Monitoring option is included in the system. It is used to record the periodic totals for Demand KW, Peak Demand, and Daily, Weekly, Monthly and Yearly usage. KW Log entries are made at midnight each day. The KW Demand totals are reset as appropriate. The Daily KW is reset each day, the Weekly KW is reset at the beginning of each week on Sunday morning, the Monthly KW is reset when the month changes and the Yearly KW resets when the year changes.

System Log (Optional)

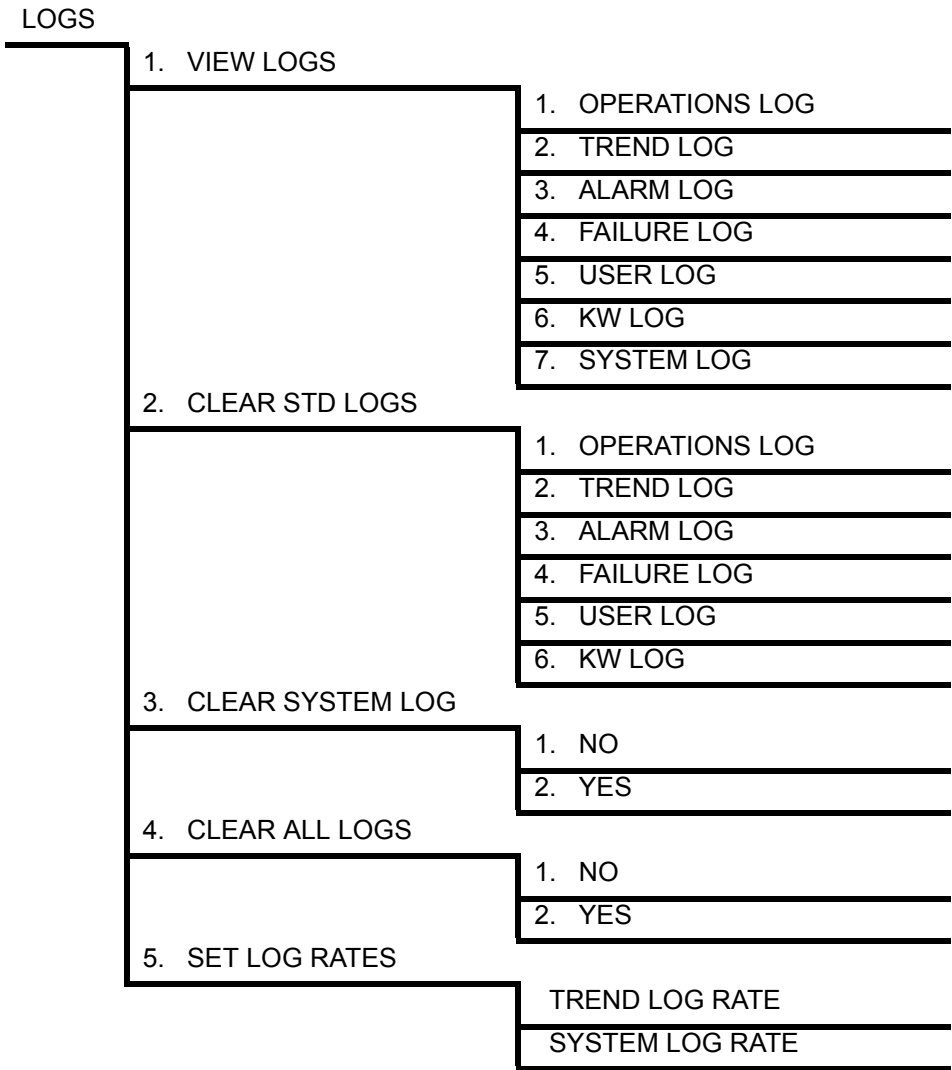
The **SYSTEM LOG** can only be utilized for a system whose Master panel is configured for communication with an M&M Refrigeration, Inc. PC Monitor™ program. When this option is active, the System Log will track and accumulate all system data such as analog, discrete, alarm and some status information. This information is held by the Master panel until a scheduled or user initiated download occurs. At that time, all system information held by the Master is downloaded to the PC Monitor.

The PC Monitor program must have the Reports or Graph Plotting options in order to utilize the System Log information. For more information about using System Log data, please refer to the M&M Systems PC Monitor User's Manual.



Logging Functions Operating Procedures

The log function is accessed by the operator through the LOGS hot key. This hot key allows the user to view or erase any of the systems available logs. A diagram of the available menu options under the LOGS hot key is shown below. The operator simply selects the menu item of the log they wish to access using standard menu screen operating procedures. The KW Log is a CCS system option. The Clear System Log and System Log Rate are System Logging options and are only available for systems which support M&M Refrigeration, Inc. PC Monitor™.



Logs Menu Diagram

The following sections will provide an operating overview of the system logs.



Operations and Trend Logs

The Operations and Trend Logs typically store the same parameters. The only difference is the time interval at which entries are made. The logs will also indicate which parameters have caused an alarm or failure by placing an indicator next to the responsible parameter. The following table shows the indicators used for each of the system alarm or failure states.

INDICATOR	STATE
A	Alarm State
F	Failure State
O	OEM Failure State

NOTE: The Operations and Trend Logs on compressors only accumulate data when the compressor is running. However, alarm and failures will still be logged when the compressor is stopped.

The following is an example of the first page of the Operations Log. This particular log has 3 different pages to display all the data.

PAGE 1/3		OPERATIONS LOG				day mm/dd/yy hh:mm:ss			
TIME	DATE	TYPE	ENTRY DESCRIPTION	ALARM	CNTRL	CNTRL	MODE	STATE	
				LEVEL	SETPT	PARAM			
#/" /F	#/" /F								
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	ALARM	SUCTION PRESSURE	LOW	XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG			XXX.X#	XXX.X#	AUTO	RUNNING	
XX:XX:XX	XX/XX	LOG	START LOCAL KEYPA		XXX.X#	XXX.X#	AUTO	RUNNING	

↑/↓ = SCROLL, PG UP, PG DOWN, ←/→ = PAGE LEFT/RIGHT, CLEAR = TOP OF PAGE

Operations Log Page

The following data descriptions apply to the Operations and Trend Logs.

PARAMETER	DEFINITION
TIME	The time the problem occurred.
DATE	The date the problem occurred.
TYPE	The type of log entry.
ENTRY DESCRIPTION	Description of the log entry if applicable.
ALARM LEVEL	The status level of the alarm/failure if one occurred.
DATA	The analogs and other data recorded for the system.

Operation Log Definitions



Alarm and Failure Logs

The Alarm and Failure Logs are records of the system alarm and failure conditions. The screen format is the same for both logs, except for the TYPE column.

ALARMS LOG				
day mm/dd/yy hh:mm:ss				
TIME	DATE	TYPE	ENTRY DESCRIPTION	ALARM LEVEL
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	HIGH
xx:xx:xx	xx/xx	ALARM	MOTOR CURRENT	HIGH
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	LOW
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	LOW
xx:xx:xx	xx/xx	ALARM	OIL PRESSURE	LOW
xx:xx:xx	xx/xx	ALARM	OIL TEMP	LOW
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	LOW
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	LOW
xx:xx:xx	xx/xx	ALARM	SUCTION PRESSURE	LOW

↑/↓ = SCROLL, PG UP, PG DOWN, ←/→ = PAGE LEFT/RIGHT, CLEAR = TOP OF PAGE

Alarm Log Page

The Alarm and Failure logs will contain the data described in the following table for each entry.

PARAMETER	DEFINITION
TIME	The time the problem occurred.
DATE	The date the problem occurred.
TYPE	The type of problem that occurred.
ENTRY DESCRIPTION	Description of the problem that set off the alarm/failure.
ALARM LEVEL	The state that caused the alarm/failure (if applicable).

Alarm Log Definitions

User Log

The User Log is a record of the last 50 user logons for the system. The following is an example of a typical User Log screen.

USER LOG			
day mm/dd/yy hh:mm:ss			
TIME	DATE	USER NUMBER	LOCATION
xx:xx:xx	xx/xx	01	LOCAL KEYPAD
xx:xx:xx	xx/xx	01	LOCAL KEYPAD
xx:xx:xx	xx/xx	02	MASTER PC COM
xx:xx:xx	xx/xx	01	LOCAL KEYPAD
xx:xx:xx	xx/xx	01	LOCAL KEYPAD

↑/↓ = SCROLL, PG UP, PG DOWN, ←/→ = PAGE LEFT/RIGHT, CLEAR = TOP OF PAGE

User Log Page

The user log will contain the data described in the following table for each entry.

PARAMETER	DEFINITION
TIME	The time the user logged onto the system.
DATE	The date the user logged onto of the system.
USER NUMBER	User identification number.
LOCATION	Where the user logged in from

User Log Definitions



KW Log (optional)

If the option is supported by your system configuration, data for KW usage is entered in the optional KW Log daily at midnight and can be reviewed by accessing the KW Log function. Below is an example of a KW Log screen for peak demand and periodic totals.

			KW LOG		day	mm/dd/yy	hh:mm:ss
	PEAK	PEAK	TOTAL	TOTAL	TOTAL	TOTAL	
	DEMAND	DEMAND	DAILY	WEEKLY	MONTHLY	YEARLY	
DATE	KW	TIME	KWH	KWH	KWH	KWH	
-----	-----	-----	-----	-----	-----	-----	-----
XX/XX/XX	XXXXXX	XX:XX:XX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX

KW Log Page

The User log will contain the data described in the following table for each entry.

PARAMETER	DEFINITION
PEAK DEMAND KW	The highest level of Demand KW detected during any 24-hour period of operation. Values are reset to the current value detected at midnight and then dynamically updated.
PEAK DEMAND TIME	The time at which the Peak Demand KW occurred.
TOTAL DAILY KWH	The total KWH used since midnight on a given day.
TOTAL WEEKLY KWH	The accumulated total KWH used during a given week. The value is reset to zero at the beginning of each week on Sunday morning.
TOTAL MONTHLY KWH	The accumulated total KWH used during a given month. The value is reset to zero at the beginning of each month.
TOTAL YEARLY KWH	The accumulated total KWH used during a given year. The value is reset to zero at the beginning of each year.

KW Log Definitions

Clear Logs

The Clear Logs function is typically not available to the user. A special one-time password is required from M&M to access this function. Please contact the M&M service department if you desire to clear the logs.

Clear Std Log

The Clear Std (Standard) Logs menu entry provides a method of erasing all the data currently contained in the six logs available for a standard system configuration. Each log must be selected individually. After choosing to clear a log the user will be prompted by a confirmation screen to verify the selection. If the user decides to continue with the clearing of the log, a momentary screen will appear with a message stating that the log has been erased. On some systems, the action of clearing the logs requires a special password. The message "ACCESS DENIED" indicates that the user does not have privilege to perform this function. If a standard user password will not allow access to clear the logs, contact your control system provider for assistance.

Clear System Log (Optional)

The Clear System Log menu entry provides a method of erasing all the data currently held on the Master panel that would be contained in the optional System Log. After choosing to clear the system log the user will be prompted by a confirmation screen to verify the selection. If the user decides to continue with the clearing of the log, a momentary screen will appear with a message stating that the log has been cleared.

Clear All Logs

The Clear All Logs menu entry provides a method of erasing all the data currently contained in all the logs available on your system. After choosing to clear all logs the user will be prompted by a confirmation screen to verify the selection. If the user decides to continue with the clearing of the logs, a momentary screen will appear with a message stating that the logs have been erased. On some systems, the action of clearing the logs requires a special password. The message "ACCESS DENIED" indicates that the user does not have privilege to perform this function. If a standard user password will not allow access to clear the logs, contact your control system provider for assistance.

Set Log Rates

The Set Log Rates menu entry allows the user to set the rate in minutes for collection of the logging data. Both Trend Log Rate (standard) and System Log Rate (optional) can be set to the rate in minutes which is most desirable for your system and operational needs.



The **MENUS** hot key allows the user to access miscellaneous screens that do not fall under one of the other hot key categories. The system supports the following four additional menus:

- Logon User
- Logoff User
- Diagnostics
- Setup

Technical Overview

Additional menus are available for system logon and logoff, basic system information for diagnostic purposes and setup of various system parameters, passwords, access levels and initialization sequences.

Logon User

To log onto the system the user selects the **LOGON USER** option and enters a numeric user password assigned by the CCS system manager. Once a password is accepted the system allows access according to the preset restrictions set by the CCS according to the access level. Please review the Screen Access Levels section for an explanation of access levels.

Logoff User

To logoff of the system the user selects the **LOGOFF USER** menu option. The system then logs the user off and changes the access levels to the default values. Please review the Screen Access Levels section for an explanation of access levels.



Automatic Log Off

A user will be automatically logged off after a 10-minute period of no keyboard activity. The system automatically returns to the main status screen.

Diagnostics Menu

The **DIAGNOSTICS** menu option permits the user to view basic information about the system. The information can then be used to readily troubleshoot problems when they occur. Most of the screens available under this menu option are view-only screens and information displayed cannot be changed by the user. There are a few screens available for certain systems, which have selected parameters for which data entry is possible. The menu selections include System Info, View I/O & Analogs, View Dip Switches and View Network Communications. On some systems, an additional Discrete I/O Override screen is provided to allow some inputs and outputs to be temporarily changed for diagnostic purposes.

System Information

Selecting **SYSTEM INFO** will display the System Information screen. Information displayed includes the dates for last memory initialization and system reset, status on system options such as modem communications and frame statistics.

View Discrete I/O

The **VIEW DISCRETE I/O** screens display discrete Input and Output information from the unit. Channel assignment, signal name, input/output designation and current state of the signal are displayed for discrete I/O racks. The specific number of I/O screens will vary depending on individual system configuration.

View Analogs

The **VIEW ANALOGS** screens display analog signal information from the unit. Channel assignment, signal name, current value, units of measurement and hexadecimal equivalent values are displayed. The specific number of analog screens will vary depending on individual system configuration.

View Dip Switches

The **VIEW DIP SWITCHES** menu selection displays switch number and state for the three banks of dip switches. The dip switch settings should only be adjusted by qualified personnel.

View Network Comm

The **VIEW NETWORK COMM** selection displays the current communication status for various units involved in system communication such as the modem, PC or other network connections. Current status, last error, total error count and message count are examples of the parameters which may be displayed here.

Override Discrete I/O (Option)

The **OVERRIDE DISCRETE I/O** screen allows the user to set the state of certain discrete outputs. It also allows the user to simulate certain discrete inputs to an active or inactive state. This feature is for diagnostics purposes only and will only function if the system is off-line. Please note that the user is responsible for knowing the consequences of manual control actions.

Setup Menu

The **SETUP** menu allows the user to perform miscellaneous setup changes, which are used to configure the system.

Set Date and Time

The **SET DATE AND TIME** screen allows the user to enter the current day and date. The system clock may be set to a 12 or 24 hour mode.

NOTE: *If the time is set on a Master panel, all the clocks on the lower-level network panels will also be set. The correct hour, minute and second for the current time must be entered as 24 hour time.*

Calibrate Sensors

Two types of calibration can be accomplished using the Dynamic or Static Sensor Calibration options. Dynamic Sensor Calibration is selected when the user wishes to change current sensor range values. Static Sensor Calibration is selected to recall sensor calibration values after a return to factory configuration or after a system software or hardware change, which would effect sensor calibration.

Dynamic Sensor Calibration

DYNAMIC SENSOR CALIBRATION is the process of adjusting the readings of the CCS analog sensors to remove small inaccuracies. The calibration process is performed from the Dynamic Sensor Calibration screen. The approach used for dynamic calibration divides the sensor range into three zones. When the value being calibrated is in the upper zone (above 66%) the upper range limit is allowed to change by a maximum of 5% and the lower range limit remains constant. This is referred to as a span change. When the value being calibrated is in the lower zone (below 33%) the lower range is allowed to change by a maximum of 5% and the upper range remains constant. This is referred to as an offset change. When the value being calibrated is in the middle zone (33% to 66%) both end points are allowed to move a maximum of 5% (typical) resulting in both a span and offset change. For best results calibration should be performed both at the operating value and at or near the lower limit. Several calibration attempts may be required to zero-in on the correct values over the full operating range.



Static Sensor Calibration

STATIC CALIBRATION is performed to reset or restore sensor calibration values after a hardware, software or factory configuration change. The previous dynamic calibration results are shown on the Static Sensor Calibration screen to allow the user to re-enter the values manually or perform a Restore operation to reset the minimum and maximum range values for the previous calibration results.

Sensors should only be calibrated by qualified personnel and always against devices known to be accurate. Refer to the information for the Calibrate Sensors screen in the Additional Menus Operating Procedures section of this manual.

Password Control

The CCS system manager will assign user numbers, passwords, screen read and write access levels and screen access requirements for all users. A user is defined as an individual or group of individuals who will be using the system. Each user of the CCS can be assigned a numeric password to define their operating privileges. The system manager's password will initially be assigned by M&M technicians upon system configuration and may be changed by the system manager if desired. All other users will be assigned a six digit password, which has an associated read and write access level. A user must enter the numeric password to log onto the system to obtain access beyond the basic system default access levels. Once a user is finished performing the task required, he may then logoff manually. If the logoff option is not selected, logoff will occur automatically after a 10 minute period of no keypad activity.

Adding/Deleting Users

The system manager is able to **ADD OR DELETE USERS** from the CCS by accessing the Add Delete User screen. A user is added by defining a password, read access level and write access level. The higher the access level the more privileges the individual will have on the system. Access levels will range from 0 to 9, with the system manager being assigned 9 for full access. The read and write features will each have their own access level with the left number being the read access level and the right number being the write access level. The read access level defines the access level at which a user may view a screen. The write access level defines the access level at which a user may change data on a screen. When a user is deleted this information is removed from the list. The maximum number of users is 10. When the system is set to Factory Configuration, User 01 is given a password of 999999 with full access. This should be changed after the password system is setup.

Screen Access Levels

The system manager can assign read and write access levels to groups of screens on the CCS by choosing the **SCREEN ACCESS LEVEL** menu selection. The specific screens available for protection will vary depending on the system configuration. Some examples of screens which might be considered for limited access are control, setpoint, calibration and initialization screens. Access for screens such as set date and time and set log rate may be less restricted.

Initialization

The **INITIALIZATION** menu selection under the Setup group allows the user to reset the system or restore factory setpoints.

Power Fail Reset

Choosing **POWER FAIL RESET** causes the software to restart using current setpoints as if a power failure occurred.

Set Factory Configuration

SET FACTORY CONFIG will initialize the system using the preset default factory configuration values. All the system setpoints and calibration data should be recorded either manually or electronically prior to performing a Factory Configuration.

Configuration

The **CONFIGURATION** menu contains menu items which need to be configured once at system startup or which do not typically require modification.

Display Setup

The **DISPLAY SETUP** screen allows the user to set the units of measure and the default display configuration.

Communication

The **COMMUNICATIONS** configuration screen (optional) allows the user to set the hardware communications parameters for the optional DF1 and Modbus communications protocol.

Motor Configuration

The **MOTOR CONFIGURATION** screen allows the user to set the Current Transformer size, motor voltage, and motor power factor. This is a very important setup screen and can affect the operation of the compressor.

Set Operating Status

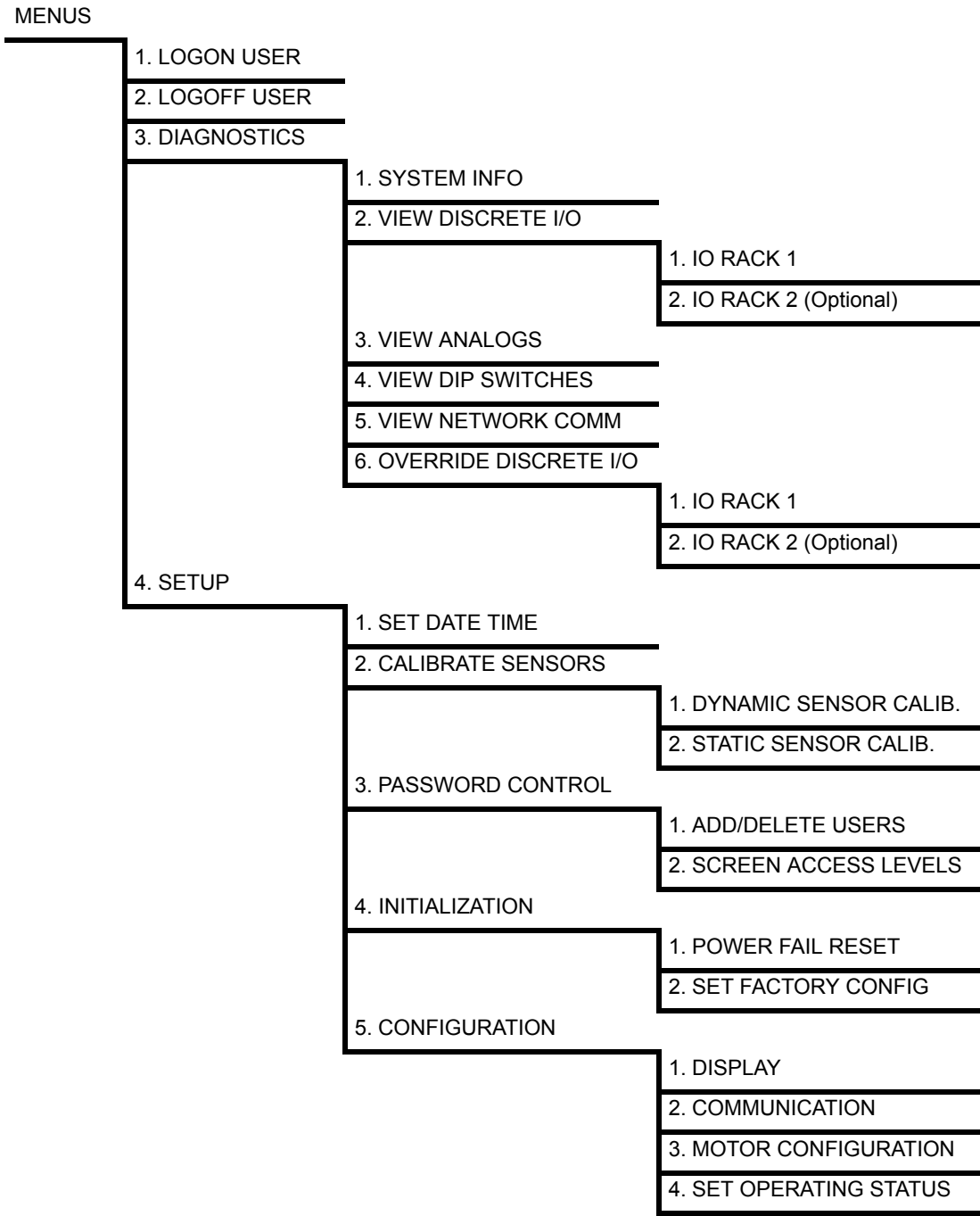
The **SET OPERATING STATUS** screen allows the user to reset the runtime and startup information of the compressor in the event that the data is lost due to a board change or factory configuration operation.



Operational Procedures

A diagram of the screens available under the **MENUS** hot key is shown below.

NOTE: Some screens are optional and may not be accessible on all compressors.



Additional Menus Diagram



Logon User

To log onto the system the user selects the **LOGON USER** option and enters the appropriate user password. Once a password is accepted the system allows access according to the restrictions preset by the CCS system manager. Below is an example of a logon screen.

M & M REFRIGERATION
8:32 AM

1. START

2. STATS

3. MODE

4. SETPT

5. SCHED

6. CNTRL

7. MISC

8. LOGS

9. **MENUS**

LOGON

ENTER PASSWORD * - - - - -

Logon User Screen

The following table lists the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
PASSWORD	The designated password for a particular user.	0-999999

Logon User Definitions


NOTE: The password is not displayed when typed. Instead, “*” characters are displayed to avoid anyone overseeing the typed password.

Logoff User

To logoff of the system the user selects the **LOGOFF USER** menu option. A temporary screen will then appear to signal the initiation of the logoff. The system then logs the user off and changes the access levels to the default values. The system automatically returns to the main status screen. A user will be automatically logged off after a 10 minute period of no keyboard activity.

Diagnostics

The **DIAGNOSTICS** menu option permits the user to view and in some cases alter basic information about the system. The menu selections include viewing System Information, Viewing IO, Analogs, and dip switches; and viewing Network Communications.

 M & M REFRIGERATION 8:32 AM

1 . START	DIAGNOSTICS
2 . STATS	1 .SYSTEM INFORMATION
3 . MODE	2 .VIEW DISCRETE I/O
4 . SETPT	3 .VIEW ANALOGS
5 . SCHED	4 .VIEW DIP SWITCHES
6 . CNTRL	5 .VIEW NETWORK COMM
7 . MISC	6 .OVERRIDE DISCRETE I/O
8 . LOGS	
9 . MENUS	

Diagnostics Screen

System Information

The **SYSTEM INFORMATION** screen is used to provide the user with the system options and software configuration status. An example of a System Information screen is shown below.

SYSTEM INFORMATION					day mm/dd/yy hh:mm:ss			
M&M REFRIGERATION INC. COPYRIGHT 1991-2001					FRAME STATISTICS			
					F0	F1	F2	F3
M&M SCREW	day mm/dd/yy	hh:mm:ss	v1.00		----	----	----	----
MEMORY INITIALIZED	: mm/dd/yy	hh:mm:ss		MAX :	xxxx	xxxx	xxxx	xxxx
SYSTEM LAST RESET	: mm/dd/yy	hh:mm:ss		AVG :	xxxx	xxxx	xxxx	xxxx
CURRENT TIME	: mm/dd/yy	hh:mm:ss	day	MIN :	xxxx	xxxx	xxxx	xxxx
TIMER STATUS	: 0 OF 0 MAX: 0							
REFRIGERANT	: R717	SEQUENCED	: NO	LUBE SYSTEM	: NO PUMP			
NETWORK CONTROL	: NO	REMOTE	: NO	UNLOAD SOL	: N/OPEN			
BYPASS SOL	: NO	AUTO-REMOTE	: NO					
ECONOMIZER SOL	: NO	PROCESS TEMP	: NO					
VARIABLE VI	: NONE	MODEM	: NO					

System Information Screen

The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
M&M Screw day mth dd year hh:mm:ss v1.00	The name, job number, and version number of the installed software.
MEMORY INITIALIZED	The date and time the memory was last initialized.
SYSTEM LAST RESET	The date and time the system was last reset.
CURRENT TIME	The current date and time for this panel.
FRAME STATISTICS	The operating performance of the microprocessor for the specific configuration of the system.
TIMER STATUS	The number of timers currently being used, the total number of available timers, and the maximum number of timers used since the last reset.
OPTIONS	The status of various options are shown on the lower section of the screen.

System Information Definitions



View Discrete I/O

The **VIEW DISCRETE I/O** screens are information screens used for viewing purposes only as shown in the following example.

SCREW COMPRESSOR				day	mm/dd/yy	hh:mm:ss	
DISCRETE I/O RACK 1A							
CH	NAME	I/O	STATE	CH	NAME	I/O	STATE
--	-----	----	-----	--	-----	----	-----
						-	
1	COMPRESSOR MOTOR	OUT	OFF	9	MOTOR STARTE AUX	IN	OPEN
2	OIL PUMP	OUT	OFF	10	AUX 1 SHUTDOWN	IN	OPEN
3	SLIDE VALVE LOAD SOL	OUT	CLOSED	11	AUX 2 SHUTDOWN	IN	OPEN
4	SLIDE VALVE UNLD SOL	OUT	CLOSED	12	ALARM SIGNAL	OUT	OFF
5				13	FAILURE SIGNAL	OUT	OFF
6	LIQ INJECTION SOL	OUT	CLOSED	14	SP BYPASS SOL	OUT	CLOSED
7	OIL HEATER RELAY	OUT	OFF	15	MIN SLIDE VALVE SWITCH	IN	OFF
8				16	MAX SLIDE VALVE SWITCH	IN	OFF

Discrete I/O Rack 1A Screen

SCREW COMPRESSOR								day	mm/dd/yy	hh:mm:ss	
DISCRETE I/O RACK 1B											
CH	NAME			I/O	STATE	CH	NAME			I/O	STATE
--	-----			----	-----	--	-----			----	-----
1	REMOTE	ACYCLE		OUT	OFF	9	REMOTE	LOAD		IN	OPEN
2	REMOTE	LIMITED		OUT	OFF	10	REMOTE	UNLOAD		IN	OPEN
3	REMOTE	MINIMAL LOAD		OUT	CLOSED	11	REMOTE	START/STOP		IN	OPEN
4	REMOTE	INTERM LOAD		OUT	CLOSED	12	REMOTE	SETPT SELECT A		IN	OFF
5	REMOTE	FULL LOAD		OUT	CLOSED	13	REMOTE	SETPT SELECT B		IN	OFF
6	REMOTE	ALARM SIGNAL		OUT	CLOSED	14					
7	REMOTE	FAILURE SIGNAL		OUT	OFF	15					
8	REMOTE	ONLINE SIGNAL		OUT	OFF	16					

Discrete I/O Rack 1B Screen

The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
CH	The discrete channel number.
NAME	The name of the discrete signal.
I/O	Shows whether the discrete is an input or an output.
STATE	The current state of the discrete signal.

Discrete I/O Rack Definitions

View Analogs

The **VIEW ANALOG INPUTS** screen can be viewed by the operator and will be displayed on a screen similar to the following example.

SCREW COMPRESSOR									
ANALOG INPUTS									
CH	NAME	VALUE	UNIT	HEX	CH	NAME	VALUE	UNIT	HEX
1	SUCTION PRESS	XXX.X	PSIG	XXXX	9	MOTOR CURRENT	XXX.X	AMPS	XXXX
2	DISCHARGE PRESS	XXX.X	PSIG	XXXX	10	SLIDE VALVE POS	XXX.X	PCT	XXXX
3	OIL PRESS AFTR FLTR	XXX.X	PSIG	XXXX	11	PROCESS TEMP	XXX.X	DEGF	XXXX
4	OIL PRESS BEFR FLTR	XXX.X	PSIG	XXXX	12				
5	DISCHARGE TEMP	XXX.X	DEGF	XXXX	13				
6	OIL TEMP	XXX.X	DEGF	XXXX	14				
7	OIL SUMP TEMP	XXX.X	DEGF	XXXX					
8	SUCTION TEMP	XXX.X	DEGF	XXXX					
						CP OIL PRESS	XXX.X	PSID	
						CP OIL FLTR DIFF PRESS	XXX.X	PSID	

Analog Inputs Screen

The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
CH	The analog channel number. CP represents a Computed Parameter derived from two or more analog channels.
NAME	The name of the analog signal.
VALUE	The decimal value of the analog input.
UNIT	The units associated with the analog input.
HEX	The hexadecimal value of the analog input.

Analog Input Definitions



View Dip Switches

The screen shown below is an example of the **VIEW DIP SWITCHES** screen used for verifying the position of the dip switches on the microprocessor board.

NOTE: Dip switches should only be adjusted by qualified personnel.

SCREW COMPRESSOR day mm/dd/yy hh:mm:ss								
DIP SWITCHES								
SW	SW1	STATE	SW	SW2	STATE	SW	SW3	STATE
--	-----	----	--	-----	----	--	-----	----
1	COMM ADDR	OFF	1	OPTION	OFF	1	OPTION	OFF
2	COMM ADDR	OFF	2	OPTION	OFF	2	OPTION	OFF
3	COMM ADDR	OFF	3	OPTION	OFF	3	OPTION	OFF
4	COMM ADDR	OFF	4	OPTION	OFF	4	OPTION	OFF
5	COMM ADDR	OFF	5	OPTION	OFF	5	OPTION	OFF
6	COMM ADDR	OFF	6	OPTION	OFF	6	OPTION	OFF
7	COMM ADDR	OFF	7	OPTION	OFF	7	OPTION	OFF
8	COMM ADDR	OFF	8	OPTION	OFF	8	OPTION	OFF
UNIT NUMBER xxx								

Screw Dip Switch Screen

The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
SW	The dip switch number.
SW1	DIP Switch 1 on the main board. Used for communications unit address
SW2	DIP Switch 2 on the main board. Used for options.
SW3	DIP Switch 3 on the main board. Used for options.
STATE	Shows whether the dip switch is in the on or off state.
UNIT NUMBER	Indicates the numeric value represented by SW1.

Screw Dip Switch Definitions

View Network Comm

The **VIEW NETWORK COMM** screen allows the user to monitor the status of the system's communication links. The screen shown below is an example of a View Network Comm screen.

COMMUNICATIONS STATUS day mm/dd/yy hh:mm:ss						
	MODEM	PC	MASTER	DF1	M&M UNIT NUMBER	xx
	-----	-----	-----	-----	DF1 UNIT NUMBER	xx
STATUS	xxxx	xxxx	xxxx	xxxx	MODBUS UNIT NUMBER	xx
LAST ERR	xxxx	xxxx	xxxx	xxxx		
TOTAL ERR	xxxx	xxxx	xxxx	xxxx	NETWORK IN CONTROL	yes
MSG COUNT	xxxx	xxxx	xxxx	xxxx		

Communications Status Screen

The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
STATUS	The status of the link to a specific unit, either pass or fail. MODEM indicates the status for the optional modem link, PC indicates the status for the optional PC connection, Master indicates the status for an optional master panel, and DF1 indicates the status for the optional DF1 communications protocol.
LAST ERR	The last error message received from each unit. The field is blank if no errors have been received.
TOTAL ERR	A hexadecimal counter of the total number of errors received by each unit. Time-out errors do not increase the total. The counter rolls over at FFFF.
MSG COUNT	A hexadecimal counter of the number of messages received by each unit. The counter rolls over at FFFF.
M&M UNIT NUMBER	The unit number for use when the compressor is communicating with an M&M master panel.
DF1 UNIT NUMBER	The unit number for use when the compressor is communicating using the optional DF1 communications protocol.
MODBUS UNIT NUMBER	The Unit Number used when the compressor is communicating using the Modbus communication protocol.
NETWORK IN CONTROL	Indicates that the Network master is in control of the compressor.

Communications Status Definitions



Override Discrete I/O

The **VERRIDE DISCRETE I/O** screens allow discrete Inputs and Outputs to be simulated whenever the compressor is stopped (some channels are not assigned). Any overridden channels will be restored to normal when the compressor is started.

SCREW COMPRESSOR				day mm/dd/yy hh:mm:ss			
OVERRIDE DISCRETE I/O RACK 1A							
CH	NAME	I/O	STATE	CH	NAME	I/O	STATE
1	COMPRESSOR MOTOR	OUT		9	MOTOR STARTER AUX	IN	AUTO
2	OIL PUMP	OUT	AUTO	10	AUX 1 SHUTDOWN	IN	AUTO
3	SLIDE VALVE LOAD SOL	OUT	AUTO	11	AUX 2 SHUTDOWN	IN	AUTO
4	SLIDE VALVE UNLD SOL	OUT	AUTO	12	ALARM SIGNAL	OUT	AUTO
5				13	FAILURE SIGNAL	OUT	AUTO
6	LIQ INJECTION SOL	OUT	AUTO	14	SP BYPASS SOL	OUT	AUTO
7	OIL HEATER RELAY	OUT	AUTO	15	MIN SLIDE VALVE SWITCH	IN	AUTO
8	OIL FLOW SWITCH	IN	AUTO	16	MAX SLIDE VALVE SWITCH	IN	AUTO

Override Discrete I/O Rack 1A Screen

SCREW COMPRESSOR					day	mm/dd/yy	hh:mm:ss		
OVERRIDE DISCRETE I/O RACK 1B									
CH	NAME		I/O	STATE	CH	NAME		I/O	STATE
1	REMOTE	ACYCLE	OUT		9	REMOTE	LOAD	IN	AUTO
2	REMOTE	LIMITED	OUT	AUTO	10	REMOTE	UNLOAD	IN	AUTO
3	REMOTE	MINIMAL LOAD	OUT	AUTO	11	REMOTE	START/STOP	IN	AUTO
4	REMOTE	INTERM LOAD	OUT	AUTO	12	REMOTE	SETPT SELECT A	IN	AUTO
5	REMOTE	FULL LOAD	OUT	AUTO	13	REMOTE	SETPT SELECT B	IN	AUTO
6	REMOTE	ALARM SIGNAL	OUT	AUTO	14				
7	REMOTE	FAILURE SIGNAL	OUT	AUTO	15				
8	REMOTE	ONLINE SIGNAL	OUT	AUTO	16				

Override Discrete I/O Rack 1B Screen

NOTE: There is no override provided for Motor Output

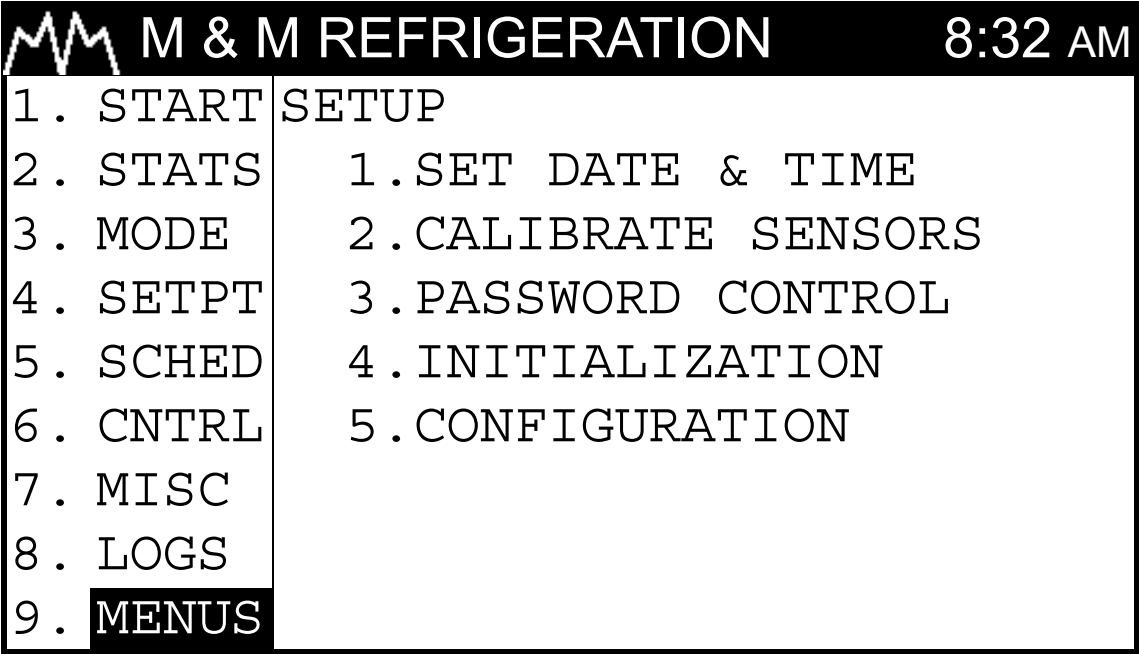
The following table lists the various parameters displayed on the screen.

PARAMETER	DEFINITION
CH	The discrete channel number.
NAME	The name of the discrete signal.
I/O	Shows whether the discrete is an input or an output.
STATE	The current state of the discrete override. AUTO indicates the output is in automatic control, OFF indicates that the output is de-energized, and ON indicates that the output is energized.

Override Discrete I/O Rack Definitions

Setup

The **SETUP** menu allows the user to perform miscellaneous setup changes, which are used to configure the system. The menu selections include Set Time Date, Calibrate Sensors, Password Control, Initialization, and Configuration.



Setup Menu Screen

Set Date & Time

The **SET DATE & TIME** screen allows the user to change the date, clock mode or time of day for the system. The clock mode gives the user the ability to display time in 24 hour or 12 hour modes. An example of the screen is shown below.

M & M REFRIGERATION		8:32 AM
1 . START	SET DATE & TIME	
2 . STATS		
3 . MODE	DAY	SUN
4 . SETPT	DATE	MM/DD/YY
5 . SCHED	24 HOUR TIME	HH:MM:SS
6 . CNTRL	CLOCK TIME	24 HOUR
7 . MISC		
8 . LOGS		
9 . MENUS		

Set Date & Time Screen

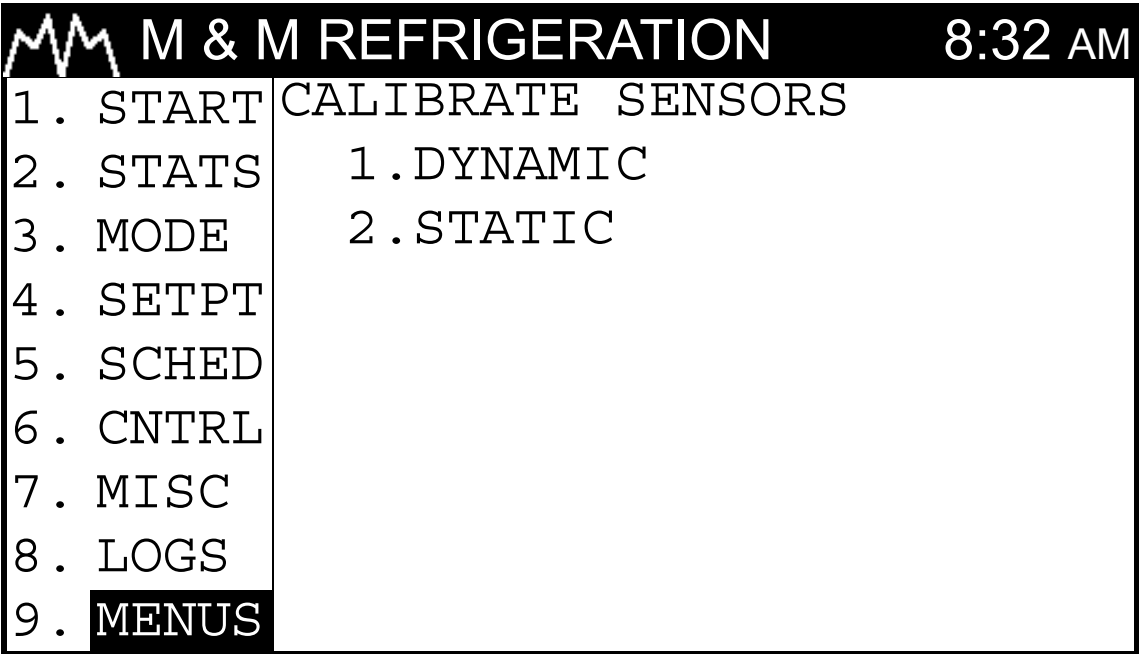
The following table lists the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
DAY	The current day of the week.	SUN - SAT
DATE	The current date entered as month, day, and year. All six digits must be entered. For example, to set the date to March 2nd, 2001, enter 03 02 01. The slash delimiter does not need to be entered.	MM/DD/YY
24 HOUR TIME	The current time of day which must be entered in military 24 hour format. This field is initially blank. The user only needs to enter enough digits to specify the required time. All unused digits will be set to zero. The colon delimiter does not need to be entered.	00:00:00 - 23:59:59
CLOCK MODE	The time display mode for the system, either 12 or 24 hour format.	12 HOUR 24 HOUR

Set Date & Time Definitions

Calibrate Sensors

The **CALIBRATE SENSORS** menu allows the user to adjust the range of sensor inputs. There are two types of calibration, Dynamic and Static. Dynamic calibration is used primarily for accurate calibration of sensor inputs where the sensor is being compared to known system conditions. Static calibration is performed to reset or restore sensor calibration values after a hardware, software or factory configuration change.



Calibrate Sensors Screen

Dynamic Sensor Calibration

DYNAMIC SENSOR CALIBRATION is described more fully in the Technical Overview section of this chapter.

SCREW COMPRESSOR				day mm/dd/yy hh:mm:ss			
DYNAMIC SENSOR CALIBRATION							
CH	NAME	VALUE	UNIT	CH	NAME	VALUE	UNIT
--	-----	-----	----	--	-----	-----	----
1	SUCTION PRESS	XXXX.X	PSIG	9	MOTOR CURRENT	XXXX.X	AMPS
2	DISCHARGE PRESS	XXXX.X	PSIG	10	SLIDE VALVE POS	XXXX.X	PCT
3	OIL PRESS AFTR FLTR	XXXX.X	PSIG	11	PROCESS TEMP	XXXX.X	DEGF
4	OIL PRESS BEFR FLTR	XXXX.X	PSIG	12			
5	DISCHARGE TEMP	XXXX.X	DEGF	13			
6	OIL TEMP	XXXX.X	DEGF	14			
7	OIL SUMP TEMP	XXXX.X	DEGF				
8	SUCTION TEMP	XXXX.X	DEGF				
	SPAN CORRECTION		XXX.X				
	OFFSET CORRECTION		XXX.X				

Dynamic Sensor Calibration Screen

The following table lists the data entry fields and a description of their purpose.

TERM	DEFINITION
CH	The discrete channel number.
NAME	The name of the discrete signal.
VALUE	Current dynamic value of the discrete signal.
UNIT	The unit of measurement for the discrete signal value.

Dynamic Sensor Calibration Definitions

Static Sensor Calibration

STATIC SENSOR CALIBRATION is described more fully in the Technical Overview section of this chapter.

SCREW COMPRESSOR				day mm/dd/yy hh:mm:ss			
STATIC SENSOR CALIBRATION							
SENSOR NAME	MIN	MAX	UNIT	SENSOR NAME	MIN	MAX	UNIT
SUCTION PRESS	XXXX.X	XXXX.X	PSIG	MOTOR CURRENT	XXXX.X	XXXX.X	AMPS
DISCHARGE PRESS	XXXX.X	XXXX.X	PSIG	SLIDE VALVE POS	XXXX.X	XXXX.X	
OIL PRESS AFTR FLTR	XXXX.X	XXXX.X	PSIG	PROCESS TEMP	XXXX.X	XXXX.X	DEGF
OIL PRESS BEFR FLTR	XXXX.X	XXXX.X	PSIG				
DISCHARGE TEMP	XXXX.X	XXXX.X	DEGF				
OIL TEMP	XXXX.X	XXXX.X	DEGF				
OIL SUMP TEMP	XXXX.X	XXXX.X	DEGF				
SUCTION TEMP	XXXX.X	XXXX.X	DEGF				
SPAN CORRECTION		xxx.x					
OFFSET CORRECTION		xxx.x					

Static Sensor Calibration Screen

The following table lists the data entry fields and a description of their purpose.

TERM	DEFINITION
SENSOR NAME	The name of the analog sensor
MIN	The minimum sensor range.
MAX	The maximum sensor range
UNIT	The unit of measurement for the sensor.

Static Sensor Calibration Definitions

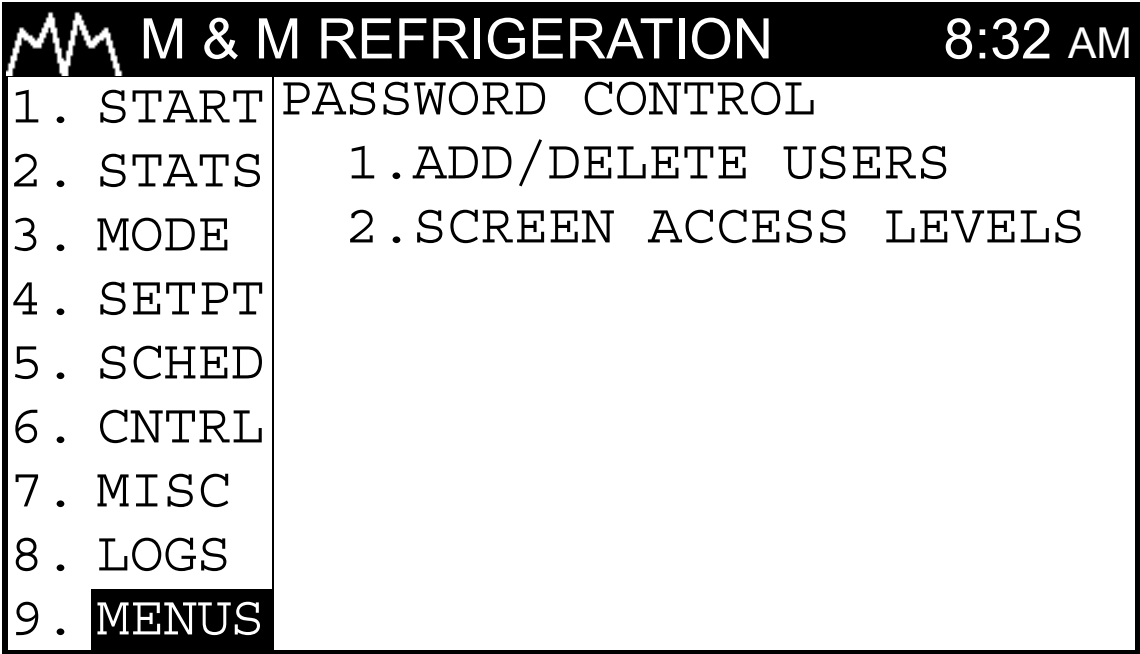
Password Control

The CCS system manager will assign each user a password to define their operating privileges. The password sets privileges for screen read and write access. The read access level defines the access level required to view a screen, while the write access level defines the access level required to change data on a screen.

Each user can be assigned a six digit password, which has associated read and write access levels. The higher the access level the more privileges the individual will have on the system. Read and write privileges will each have their own access level. The system manager can assign read and write access levels to numerous screens on the CCS. The CCS password protection is controlled through two system screens, the



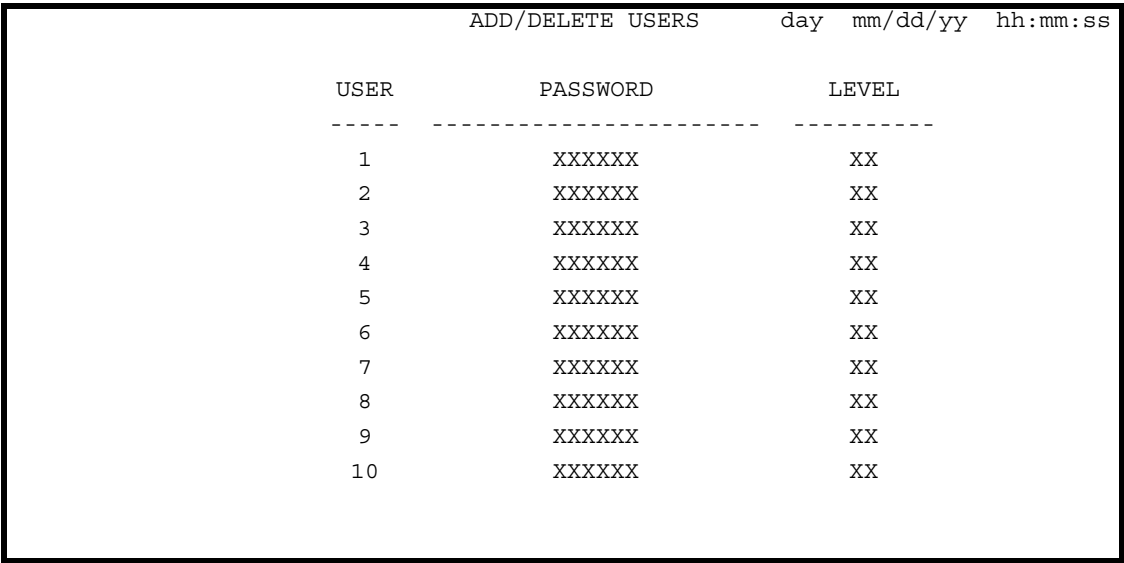
The Add/Delete User screen and the Screen Access Level screen are discussed in the following sections.



Password Control Screen

Add/Delete User

The **ADD/DELETE USER** screen will allow for the addition or deletion of a user. This function is performed by creating or deleting a password and corresponding access levels for a particular user. An example of the screen is shown below.



Add/Delete User Screen

The following table lists the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
PASSWORD	The desired password for each user.	0 - 999999
LEVEL	The desired read and write levels for each user. The first digit is the read level and the second is the write level. The lowest level of access is 0 and 9 is the highest level.	0 - 9 (per digit)

Add/Delete User Definitions

Screen Access Levels

SCREEN ACCESS authorization levels are selected for various screen sections using the Screen Access Levels screen. This allows the system manager to restrict user access to certain areas of the system. An example of a Screen Access Level screen is shown below.

SCREEN ACCESS LEVELS				day	mm/dd/yy	hh:mm:ss
FUNCTION NAME		ACCESS LEVEL READ/WRITE	FUNCTION NAME		ACCESS LEVEL READ/WRITE	
-----		-----	-----		-----	
START COMPRESSOR			SET DATE & TIME			
			CALIBRATE SENSORS		xx	
STOP COMPRESSOR FROM PC		xx	PASSWORD CONTROL		xx	
STOP COMPRESSOR FROM MODEM		xx	INITIALIZATION		xx	
			CONFIGURATION		xx	
CHANGE OPERATING MODES		xx				
SETPOINTS		xx	SET LOG RATES		xx	
CAPACITY CONTROLS		xx				
SCHEDULING		xx				
MISCELLANEOUS CONTROLS		xx				

Screen Access Level

The following table list the data entry fields and a description of their purpose.

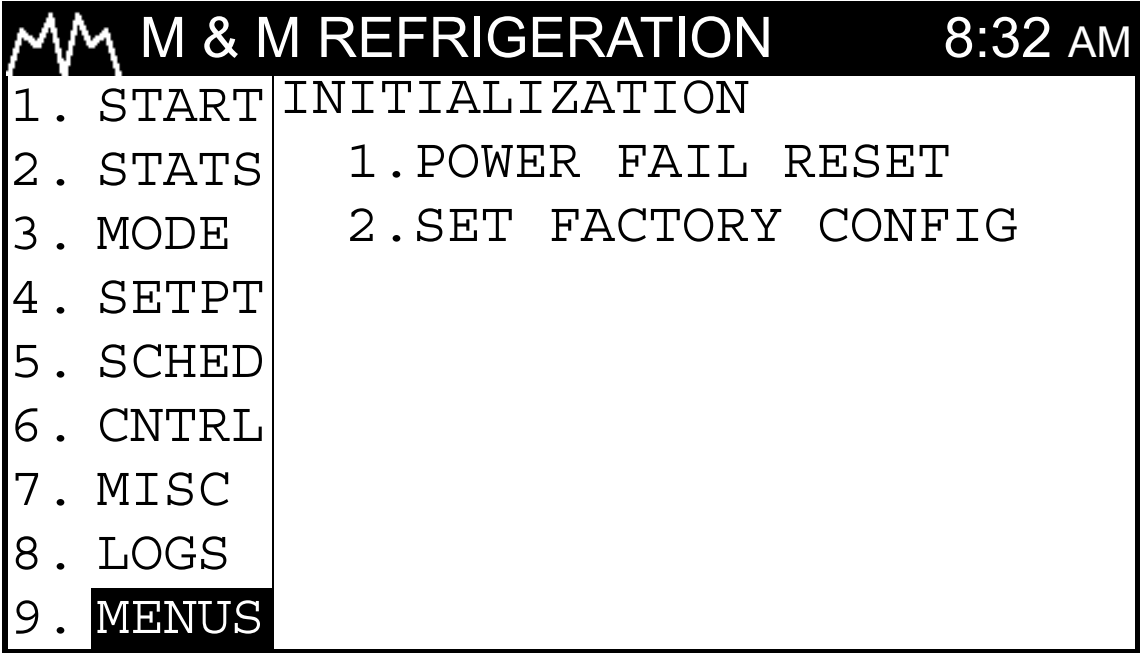
TERM	DEFINITION	RANGE
ACCESS LEVEL READ/WRITE	The desired read and write levels for each user. The first digit is the read level and the second is the write level. The lowest level of access is 0 and 9 is the highest level.	0 - 9 (per digit)

Screen Access Level Definitions



Initialization

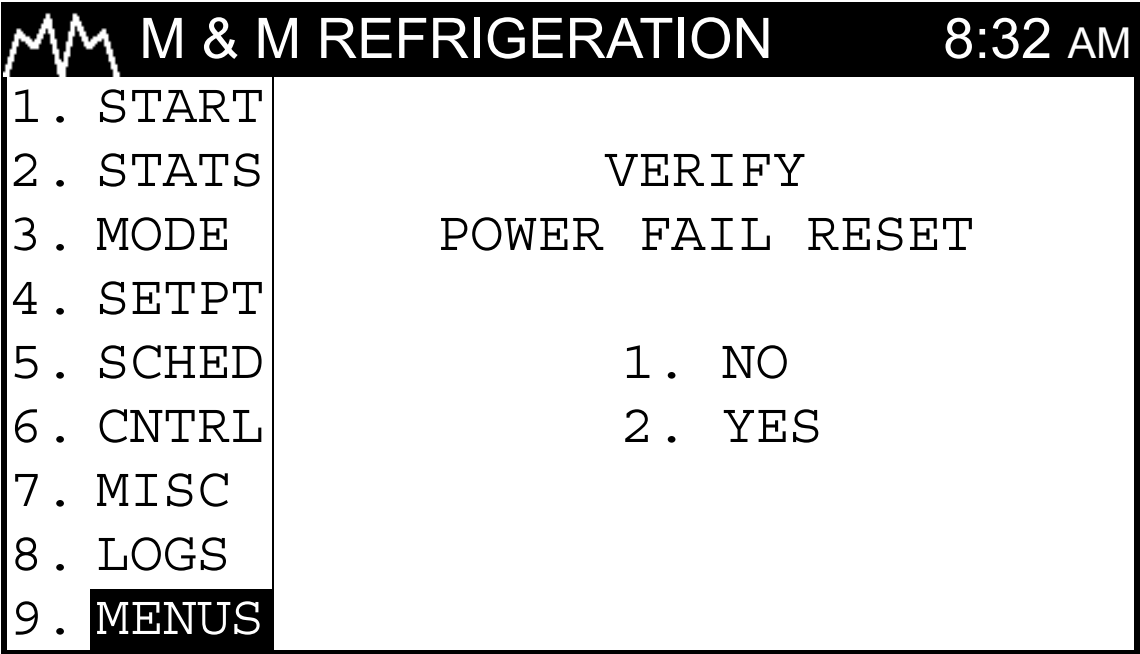
The **INITIALIZATION** menu selection under the Setup group includes Power Fail Reset and Set Factory Config. These screens are discussed further in the following sections.



Initialization Screen

Power Fail Reset

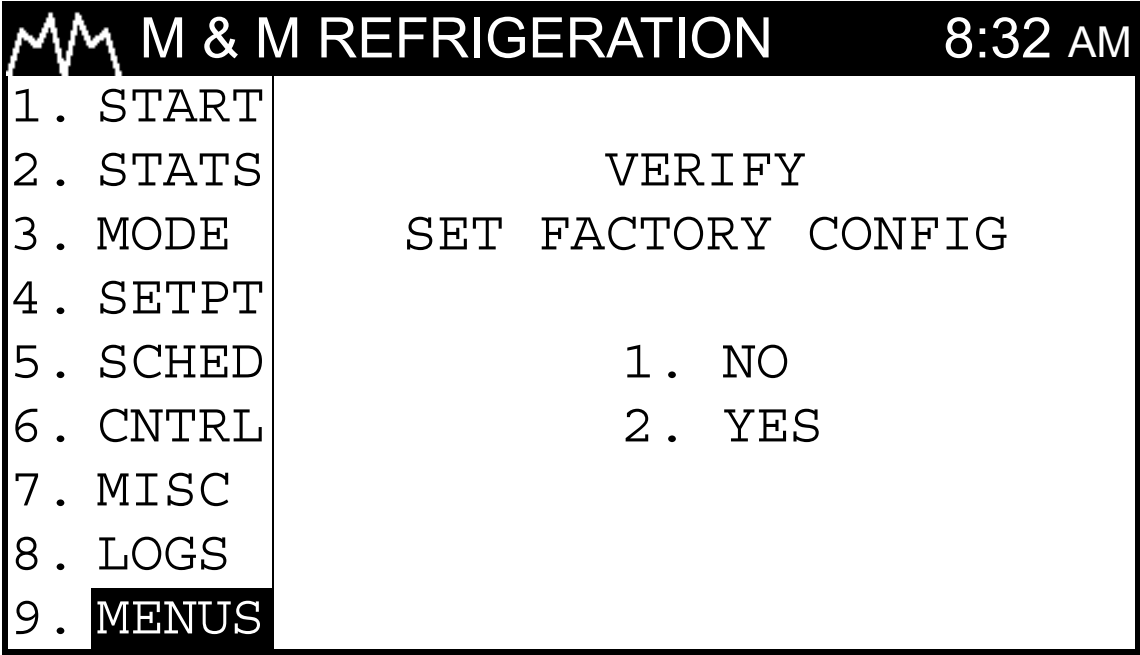
Selection of this initialization option causes the software to restart using the current setpoints as if a power failure occurred. When the user selects **POWER FAIL RESET**, a confirmation screen will be displayed asking the user to verify that he wishes to reset the system. If the user answers yes the system will restart as if a power failure occurred.



Power Fail Reset Screen

Set Factory Config


This selection allows the user to reset the system to factory default values. When the user selects the **SET FACTORY CONFIG** menu option a confirmation screen will be displayed asking the user to verify that he wishes to reset the system to the original factory configuration. If the user answers yes the system will be reset and all existing configuration changes will be lost. This includes all logs, set-points, controls, modes, etc. Do not use this option without proper consideration of the results.



Set Factory Configuration Screen

Configuration

The **CONFIGURATION** menu selection allows the user to setup various basic system parameters for the display and operation of the compressor. These parameters are usually setup once and never change.

 M & M REFRIGERATION		8:32 AM
1 . START	CONFIGURATION	
2 . STATS	1 . DISPLAY	
3 . MODE	2 . COMMUNICATIONS	
4 . SETPT	3 . MOTOR CONFIGURATION	
5 . SCHED	4 . SET OPERATING STATUS	
6 . CNTRL		
7 . MISC		
8 . LOGS		
9 . MENUS		

Configuration Screen

Display

The **DISPLAY SETUP** screen allows the user to configure the display units, default status screen, and the compressor model for use in displaying the proper graphics image.

DISPLAY SETUP		day mm/dd/yy hh:mm:ss
PRESSURE DISPLAY UNITS	PSIG	
TEMPERATURE DISPLAY UNITS	DEGF	

Display Screen

The following table list the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
PRESSURE DISPLAY UNITS	Selects the units of measure for pressure fields.	PSIG/KPAG/BAR
TEMPERATURE DISPLAY UNITS	Selects the units of measure for temperature fields.	DEGF/DEGC
DEFAULT STATUS SCREEN	Selects the screen to be used as the default display. GRAPHICS selects the graphics screen and MAIN selects the Main status screen.	GRAPHICS/MAIN
GRAPHICS MODEL	Selects the model of the compressor for graphics purposes.	MYCOM/WRV

Display Definitions

Communication Setup

The following table is a sample **COMMUNICATIONS SETUP** screen for DF1 and Modbus Communications.

COMMUNICATIONS SETUP day mm/dd/yy hh:mm:ss			
MODBUS RTU PROTOCOL (COMM1)		DF1 PROTOCOL (EXT PORT_2)	
UNIT NUMBER	xxx	UNIT NUMBER	xxx
BAUD RATE	9600	BAUD RATE	9600
DATA BITS		DATA BITS	
PARITY	NONE	PARITY	NONE
STOP BITS		STOP BITS	

Communications Screen

The following table list the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
UNIT NUMBER	Selects the unit number for communication. The unit number initializes to the same as the M&M unit number but thereafter can be changed by the user.	0-255
BAUD RATE	Selects the baud rate for communications.	2400/4800/9600/19200
DATA BITS	Selects the number of Databits used for communication.	7/8
PARITY	Sets the Parity used for communication.	None/Odd/Even
STOP BITS	Sets the number of Stop Bits to be used for communication.	1/2

Communications Definitions



Motor Configuration

The following table is a sample **MOTOR CONFIGURATION** screen.

M & M REFRIGERATION		8:32 AM
1 . START	MOTOR CONFIG	
2 . STATS		
3 . MODE	CT SIZE	XXX.X AMPS
4 . SETPT	MOTOR VOLTS	XXX VOLT
5 . SCHED	POWER FACTOR	XXX.X PCT
6 . CNTRL		
7 . MISC		
8 . LOGS		
9 . MENUS		

Motor Configuration Screen

The following table list the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
CT SIZE	Selects the size of the primary Current Transformer in the motor starter. For example, a value of 500.0 amps represents a CT with a 500:5 turns ratio.	0 - 2000 AMPS
MOTOR VOLTS	Selects the voltage rating for the motor.	110 - 5000 VOLTS
POWER FACTOR	Selects the power factor rating for the motor.	0-100 PCT

Motor Configuration Definitions

NOTE: Changing the CT Size may automatically adjust the Motor Current Setpoints.

Set Operating Status

The **SET OPERATING STATUS** screen is used to reset the total runtime hours and number of starts following a board change or software update.

M & M REFRIGERATION		8:32 AM
1. START	SET OPERATING STATUS	
2. STATS		
3. MODE	TOTAL HOURS XXXXXX.X HRS	
4. SETPT		
5. SCHED		
6. CNTRL	STARTS TODAY	XXX
7. MISC	STARTS YESTERDAY	XXX
8. LOGS	STARTS TOTAL	XXXXXX
9. MENUS		

Set Operating Status Screen

The following table list the data entry fields and a description of their purpose.

TERM	DEFINITION	RANGE
TOTAL HOURS	Sets the total runtime hours for the compressor.	0-999999.9 HRS
STARTS TODAY	Sets the total number of starts since midnight today.	0-999
STARTS YESTERDAY	Sets the total number of starts for yesterday.	0-999
STARTS TOTAL	Sets to total number of starts for the compressor.	0-999999

Operating Status Definitions



The Alarm and Failure Data Appendix provides a table which describes all of the analog and discrete alarms in the system. The Level column describes the type of alarm or failure and the Default column lists the factory setpoint for analog alarms.

Analog Alarms

No.	Parameter Name	Level	Default	Comments
1.	High Suction Pressure	Fail	70 PSIG	
2.	High Suction Pressure	Alarm	50 PSIG	
3.	Low Suction Pressure	Alarm	28 INHG	
4.	Low Suction Pressure	Fail	29.9 INHG	
5.	Low Suction Pressure	OEM	29.9 INHG	
6.	High Discharge Pressure	OEM		225 PSIG for NH3 275 PSIG for R22
7.	High Discharge Pressure	Fail		225 PSIG for NH3 275 PSIG for R22
8.	High Discharge Pressure	Alarm	215 DEGF	
9.	High Discharge Temperature	OEM	212 DEGF	
10.	High Discharge Temperature	Fail	212 DEGF	
11.	High Discharge Temperature	Alarm	200 DEGF	
12.	High Oil Temperature	OEM	180 DEGF	
13.	High Oil Temperature	Fail	155 DEGF	
14.	High Oil Temperature	Alarm	140 DEGF	
15.	Low Oil Sump Temperature	Alarm	85 DEGF	
16.	Low Oil Sump Temperature	Fail	80 DEGF	
17.	Low Oil Sump Temperature	OEM	50 DEGF	
18.	High Motor Current	OEM		Based on CT 90 % of CT
19.	High Motor Current	Fail		Based on CT 85 % of CT
20.	High Motor Current	Alarm		Based on CT 85 % of CT
21.	Low Oil Pressure	Alarm		M,D,H,W series = 22 PSIG S series = 15 PSIG A series = 15 PSIG with pump A series = 50 PSIG without pump



No.	Parameter Name	Level	Default	Comments
22.	Low Oil Pressure	Fail		M,D,HW series = 20 PSIG S series = 10 PSIG A series = 10 PSIG with pump A series = 37 PSIG without pump
23.	Low Oil Pressure	OEM		M,D,HW series = 20 PSIG S series = 10 PSIG A series = 8 PSIG with pump A series = 37 PSIG without pump
24.	High Oil Filter Differential Pressure	Alarm	15 PSIG	
25.	High Process Temperature (Option)	Fail	50 DEGF	
26.	High Process Temperature (Option)	Alarm	45 DEGF	
27.	Low Process Temperature (Option)	Alarm	30 DEGF	
28.	Low Process Temperature (Option)	Fail	25 DEGF	
29.	M,D,HW Series, RWB, RDB, RXB & Sullair: High Oil Pressure A Series: High Oil Filter Diff Pressure All Others: Spare	OEM OEM	200 PSID 25 PSID	
30.	M,D,HW Series, RWB, RDB, RXB & Sullair: High Oil Pressure Others: Spare	ALARM	200 PSID	
31.	M,D,HW Series, RWB, RDB, RXB & Sullair: High Oil Pressure All Others - Spare	ALARM	190 PSID	
32.	Spare			

Discrete Alarms

No.	Parameter Name	Level	Comments
1.	Memory Initialized	Alarm	
2.	Frame Overrun	Alarm	
3.	Timer Allocation	Fail	
4.	RAM Size Failure Low	Fail	Indicates a hardware problem with the RAM Chip.
5.	Power Low Reset	Fail	The Power has drooped below a threshold but did not completely go away. A sensor or other device may be shorted
6.	Power Fail Reset	Fail	Power was lost
7.	Pushbutton Reset	Fail	The reset button on Main Board was pressed.
8.	Watchdog Reset	Fail	The Software was unable to complete it's cycle. May be communications or interrupt related.
9.	Operator Reset	Fail	Reset from a screen save from the keypad or PC
10.	Auxiliary Contact 1	Fail	Open to Fail
11.	Auxiliary Contact 2	Fail	Open to Fail (Not available with Economizer Option)
12.	Suction Pressure Sensor Bad	SNSR	
13.	Discharge Pressure Sensor Bad	SNSR	
14.	Oil Press After Filter Sensor Bad	SNSR	
15.	Oil Press Before Filter Sensor Bad	SNSR	Oil pressure below filter sensor bad (all others) Oil pressure above discharge sensor bad (STAL)
16.	Discharge Temperature Sensor Bad	SNSR	
17.	Oil Temperature Sensor Bad	SNSR	
18.	Oil Sump Temperature Sensor Bad	SNSR	
19.	Suction Temperature Sensor Bad	SNSR	
20.	Motor Current Sensor Bad	SNSR	
21.	Slide Valve Sensor Bad	SNSR	
22.	Process Temperature Sensor Bad (Option)	SNSR	
23.	Starting Oil Pressure Low	OEM	
24.	Starting Slide Valve Position High	Fail	
25.	Stopping Slide Valve Position High	Fail	



No.	Parameter Name	Level	Comments
26.	Motor Off/Current Normal/Aux Open	Fail	The Micro checks state of Motor Output, Aux Input, and Motor Current to verify correct operation. Motor Current above 10% of entered CT size or Aux contact closed indicates the motor is running. If Motor is running when it should be off, the Micro will take the following steps: (1) Failure signal is generated to alert operator; (2) Oil pump is started, if one exists; (3) Slide valve is forced to continuous unload, and; (4) Liquid injection controls on oil temperature
27.	Motor On/Current Low/Aux Open	Fail	
28.	Motor On/Current Normal/Aux Open	Fail	
29.	Motor Off/Current Low/Aux Closed	Fail	
30.	Motor Off/Current Normal/Aux Closed	Fail	
31.	Motor On/Current Low/Aux Closed	Fail	
32.	Economizer Shutdown (Option)	Fail	Replaces Aux 2 Shutdown
33.	Master Shutdown	Fail	The master has requested a shutdown
34.	ECP Shutdown	Fail	A shutdown was requested using the ECP or Modbus protocol
35.	DF1 Shutdown	Fail	A shutdown was requested using the DF1 Protocol
36.	VI Sensor Bad Oil Level Float Spare	SNSR Fail	A Series and RWB: VI Sensor HX Series: Oil level float All Others: Spare
37.	Oil Flow Switch Oil Level Float Spare	Fail Fail	A Series: Oil Flow Switch RWB: Oil Level Float All Others: Spare
38.	Spare		
39.	Spare		
40.	Spare		

The Analog and Discrete I/O section identifies the channel assignments for sensor inputs, control outputs, and status inputs for various compressor models.

Analog Inputs

Screw Compressor - Analog Inputs					
TYPE	CHANNEL	NAME	RANGE	UNITS	SENSOR TYPE
PRESS	1	SUCTION PRESS	0 : 200	PSIA	4 - 20 mA
PRESS	2	DISCHARGE PRESS	0 : 500	PSIG	4 - 20 mA
PRESS	3	OIL PRESS AFTER FILTER	0 : 500	PSIG	4 - 20 mA
PRESS	4	OIL PRESS BEFORE FILTER (All Others) OIL PRESS ABOVE DISCHARGE (S Series)	0 : 500	PSIG	4 - 20 mA
WELL TEMP	5	DISCHARGE TEMP	32 : 302	DEGF	4 - 20 mA
WELL TEMP	6	OIL TEMP	32 : 302	DEGF	4 - 20 mA
WELL TEMP	7	OIL SUMP TEMP	32 : 302	DEGF	4 - 20 mA
TEMP	8	SUCTION TEMP	-58 : 122	DEGF	4 - 20 mA
CURRENT	9	MOTOR CURRENT		AMPS	
CAPACITY	10	SLIDE VALVE (If applicable)	0 : 100	PCT	1-5 VDC or 4 - 20 mA
WELL TEMP	11	PROCESS TEMP (Option)	-58 : 122	DEGF	4 - 20 mA
	12				
	13				
VI	14	Vi SLIDE STOP (Option)		NULL	
	15				
	16				

Discrete I/O RACK 1

Screw Compressor - Analog Inputs					
TYPE	CHANNEL	NAME	RANGE	UNITS	NOTES
OUTPUT	1	COMPRESSOR MOTOR	OFF	ON	
OUTPUT	2	MAIN OR PRE-LUBE OIL PUMP MOTOR	OFF	ON	
OUTPUT	3	SLIDE VALVE LOAD SOL (All Others) CAPACITY 100% (RDB)	CLOSED OFF	OPEN ON	
OUTPUT	4	SLIDE VALVE UNLOAD SOL (All Others) CAPACITY 100% (RDB)	CLOSED OFF	OPEN ON	
OUTPUT	5	FAST UNLOAD SOL (All Others) HIGH LOW V _i LIQ INJ SOL (RWB) SPARE (M,D, HW)	CLOSED CLOSED	OPEN OPEN	
OUTPUT	6	LIQUID INJECTION SOL	CLOSED	OPEN	
OUTPUT	7	OIL HEATER RELAY	OFF	ON	
INPUT	8	OIL FLOW SWITCH (A) OIL LEVEL FLOAT (HX, RWB) SPARE (All Others)	OPEN OPEN	CLOSED CLOSED	
INPUT	9	MOTOR STARTER AUX	OPEN	CLOSED	1
INPUT	10	AUX 1 SHUTDOWN	ALARM	NORM	3
INPUT	11	AUX 2 SHUTDOWN	ALARM	NORM	3
OUTPUT	12	ALARM/FAILURE SIGNAL	NORM	ALARM	
OUTPUT	13	FAILURE SIGNAL	NORM	ALARM	
OUTPUT	14	SUCTION BYPASS SOL (All Others) POWER ASSIST SOL (RWB, RDB)	CLOSED CLOSED	OPEN OPEN	Option
OUTPUT INPUT	15	ECONOMIZER SOL (All Others) MIN SLIDE VALVE SWITCH (IDR, SULLAIR)	CLOSED OPEN	OPEN	Option
INPUT	16	MAXSLIDE VALVE SWITCH (IDR, SULLAIR) SPARE (All Others)	OPEN	CLOSED	
OUTPUT	17	REMOTE ANTI-CYCLE	OFF	ON	Option
OUTPUT	18	REMOTE LIMITED UNLOAD	OFF	ON	Option
OUTPUT	19	REMOTE MINIMAL LOAD (All Others) REMOTE 50% OUTPUT (RDB)	OFF OFF	ON ON	Option
OUTPUT	20	REMOTE INTERMEDIATE LOAD (All Others) REMOTE 75% OUTPUT (RDB)	OFF OFF	ON ON	Option
OUTPUT	21	REMOTE FULL LOAD (All Others) REMOTE 100% OUTPUT (RDB)	OFF OFF	ON ON	Option
OUTPUT	22	REMOTE ALARM SIGNAL	NORM	ALARM	Option
OUTPUT	23	REMOTE FAILURE SIGNAL	NORM	ALARM	Option
OUTPUT	24	REMOTE ONLINE SIGNAL	OFF	ON	Option
INPUT	25	REMOTE LOAD (All Others) REMOTE 75% CAPACITY (RDB)	OFF OFF	ON ON	Option
INPUT	26	REMOTE UNLOAD (All Others) REMOTE 100% CAPACITY (RDB)	OFF OFF	ON ON	Option
INPUT	27	REMOTE START/STOP	OFF	ON	Option
INPUT	28	REMOTE SETPOINT SELECT A	OFF	ON	Option
INPUT	29	REMOTE SETPOINT SELECT B	OFF	ON	Option

OUTPUT	30	Vi INCREASE SOL (All Others) Vi INCREASE SOL <i>FUTURE</i> (HX) SPARE (S, RDB, IDR, SULLAIR)	CLOSED	OPEN	Option
OUTPUT	31	Vi DECREASE SOL (All Others) Vi DECREASE SOL <i>FUTURE</i> (HX) SPARE (S, RDB, IDR, SULLAIR)	CLOSED	OPEN	Option
	32				

NOTES:

- | | |
|---|---|
| 1 -Normally open contact with no power or level | 5 – De-energize for condition |
| 2 -Normally closed contact with no power or level | 6 – Pilot driven – Energize to close |
| 3 -Normally closed contact open to fail | 7 – De-energized to turn on via customer supplied relay |
| 4 -Energize for condition | |



Introduction

The hardware interface and software protocol are defined for performing serial communications with the M&M screw compressor Computer Control System (CCS). Two open protocols are defined in this document, Modbus RTU and Allen-Bradley (AB) DF1. In each case, the implementation of each protocol is limited to the sub-set of the complete set of possible message types. Communications with one or more compressors is possible using a multi-drop RS-422 interface. M&M Refrigeration also supports its own internal communications protocol which is available upon request.

NOTE: *Modbus is a registered trademark of Modicon, Inc.*

Real time monitoring of the following data is provided:

- Analog input parameters
- Discrete I/O parameters
- Mode and State information
- Computed parameters
- Alarm Information

Real time control of the following parameters is provided:

- Compressor Control including start/stop and mode changes
- Compressor Capacity Control Setpoints
- Economizer Control (optional)

Applicable Documents

Familiarity with the following documents is highly recommended:

- M&M Refrigeration CCS Screw Compressor Overview
- Modicon Modbus Protocol Reference Guide (PI-MBUS-300)
- Allen-Bradley DF1 Protocol and Command Set (1770-6.5.16)
- Allen-Bradley Enhanced and Ethernet PLC-5 Programmable Controllers (1785-6.5.12)



Hardware Interface Description

Hardware Requirements

The M&M Screw compressor uses the on-board COMM 1 port for Modbus communications and PORT 2 on the optional Communications Expansion board for DF1 communications. The hardware configuration for both protocols is 5-volt RS-422.

Interface Connections

Physical interface connections for Modbus communications are made at COMM 1 located on the right side of the lower edge of the main microprocessor board next to the battery. The interface connection for DF1 communications are made at PORT 2 on the optional Communications Expansion board. The following table shows the pin-outs for the M&M hardware for both COMM 1 and PORT 2.

Pin	Name	Function
1	TX+	Transmit Data (Positive)
2	TX-	Transmit Data (Negative)
3	GND	Ground
4	GND	Ground
5	RX-	Receive Data (Negative)
6	RX+	Receive Data (Positive)

The use of low capacitance twisted/shielded cable is required (e.g. Belden #9503 or eq.). The shields should be grounded at the master computer end of the cable and floated at the microprocessor end.

Figure 1 shows the interface cabling connections for typical Modbus applications. Also shown are the recommended shield grounding requirements for an in-line data path and a split data path. Other controllers or PC configurations may be different.

NOTE: Since Modbus communications share a port with M&M communications, Dip switch SW3 Position 7 on the main board must be set to the ON position to enable the Modbus communications protocol.

DF1 communications, the M&M controller must be outfitted with the optional Communications Expansion board. The board must be configured with external serial port 2 enabled. Figure 2 shows a typical connection for an Allen-Bradley PLC-5 using an RS-232C/RS-422 adapter to multiple M&M compressors. The Allen-Bradley programmable controller must be configured for RS-422 multi-drop communications.

NOTE: The AB PLC-5/60 Comm port 0 may be configured as RS-422 multi-drop. However, the implementation is non-standard and is limited as to the communications speed and wire length. The signal levels are also inverted from normal RS422. The use of an external RS232-to-RS422 converter is recommended to allow standard high-speed long-distance communications.

The following pin-outs apply to the Comm 0 port of the PLC/5-60 programmable controller.

Pin	RS-232C	RS-422A	RS-423
1	C.GND	C.GND	C.GND
2	TXD.OUT	TXD.OUT ⁺	TXD.OUT
3	RXD.IN	RXD.IN ⁺	RXD.OUT
4	RTS.OUT	RTS.OUT ⁺	RTS.OUT
5	CTS.IN	CTS.IN ⁺	CTS.IN
6	DSR.IN	DSR.IN	DSR.IN
7	SIG.GND	SIG.GND	SIG.GND
8	DCD.IN	DCD.IN	DCD.IN
9			
10	NOT USED	DCD.IN	NOT USED
11			
12			
13	NOT USED	CTS.IN	NOT USED

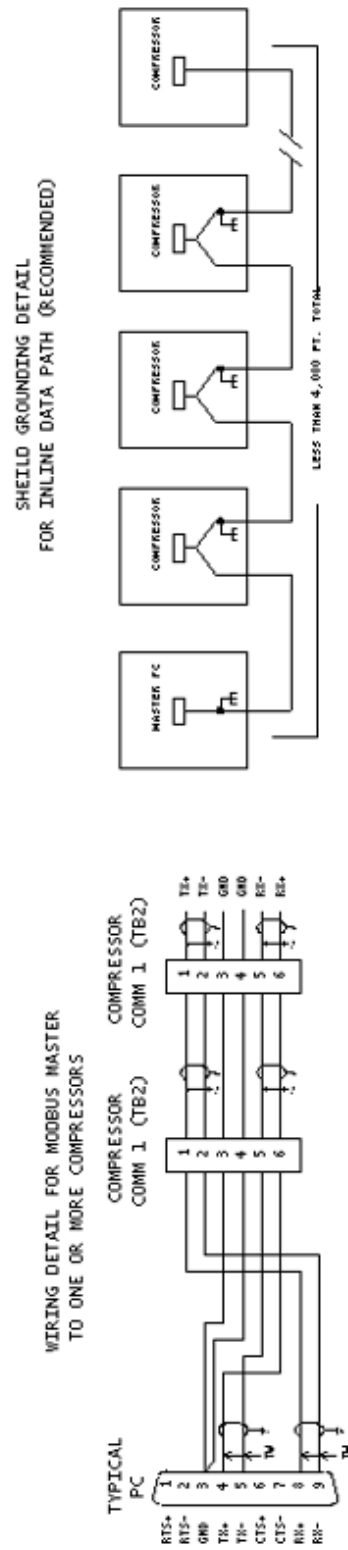
Pin	RS-232C	RS-422A	RS-423
14	NOT USED	TXD.OUT	SEND COM
15			
16	NOT USED	RXD.IN	REC COM
17			
18			
19	NOT USED	RTS.OUT	NOT USED
20	DTR.OUT	DTR.OUT	DTR.OUT
21			
22	NOT USED	DSR.IN	NOT USED
23	NOT USED	DTR.OUT	NOT USED
24			
25			



Message Addressing

Each compressor is required to have a unique address referred to as the unit number. The unit number is initially set using dip switch SW1 on the main microprocessor board. However, the actual unit number can be changed through software by setting the Modbus or DF1 unit number on the appropriate setup screen on the controller. The following table shows the dip switch settings for up to 31 individual screw compressors.

UNIT NUM	DIP SWITCH								UNIT NUM	DIP SWITCH							
	8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	17	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	18	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	19	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	20	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	21	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	22	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	23	OFF	OFF	OFF	ON	OFF	ON	ON	ON
8	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	24	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	25	OFF	OFF	OFF	ON	ON	OFF	OFF	ON
10	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	26	OFF	OFF	OFF	ON	ON	OFF	ON	OFF
11	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	27	OFF	OFF	OFF	ON	ON	OFF	ON	ON
12	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	28	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
13	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	29	OFF	OFF	OFF	ON	ON	ON	OFF	ON
14	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	30	OFF	OFF	OFF	ON	ON	ON	ON	OFF
15	OFF	OFF	OFF	OFF	ON	ON	ON	ON	31	OFF	OFF	OFF	ON	ON	ON	ON	ON
16	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF									



NOTES:

1. GROUND THE SHIELD DRAIN WIRE TO THE ENCLOSURE AT THE UPSTREAM END OF EACH CABLE. THE UPSTREAM END OF THE CABLE IS THE END NEAREST THE PC. FLOAT THE SHIELD DRAIN WIRE AT THE DOWNSTREAM END.
2. COMMUNICATIONS CABLE IS BELDEN #9503 OR EQUIVALENT.

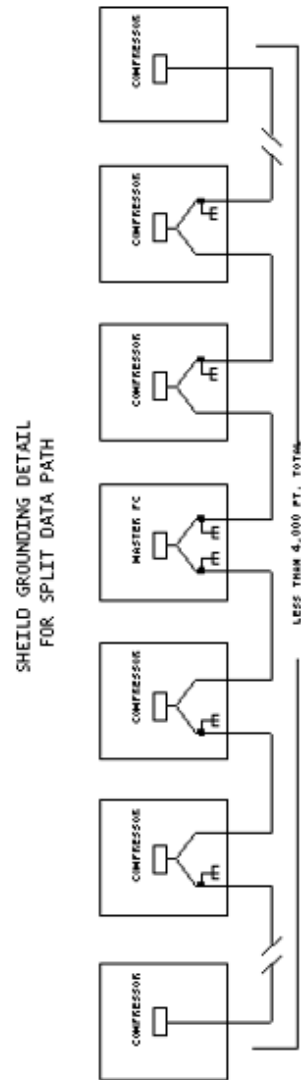
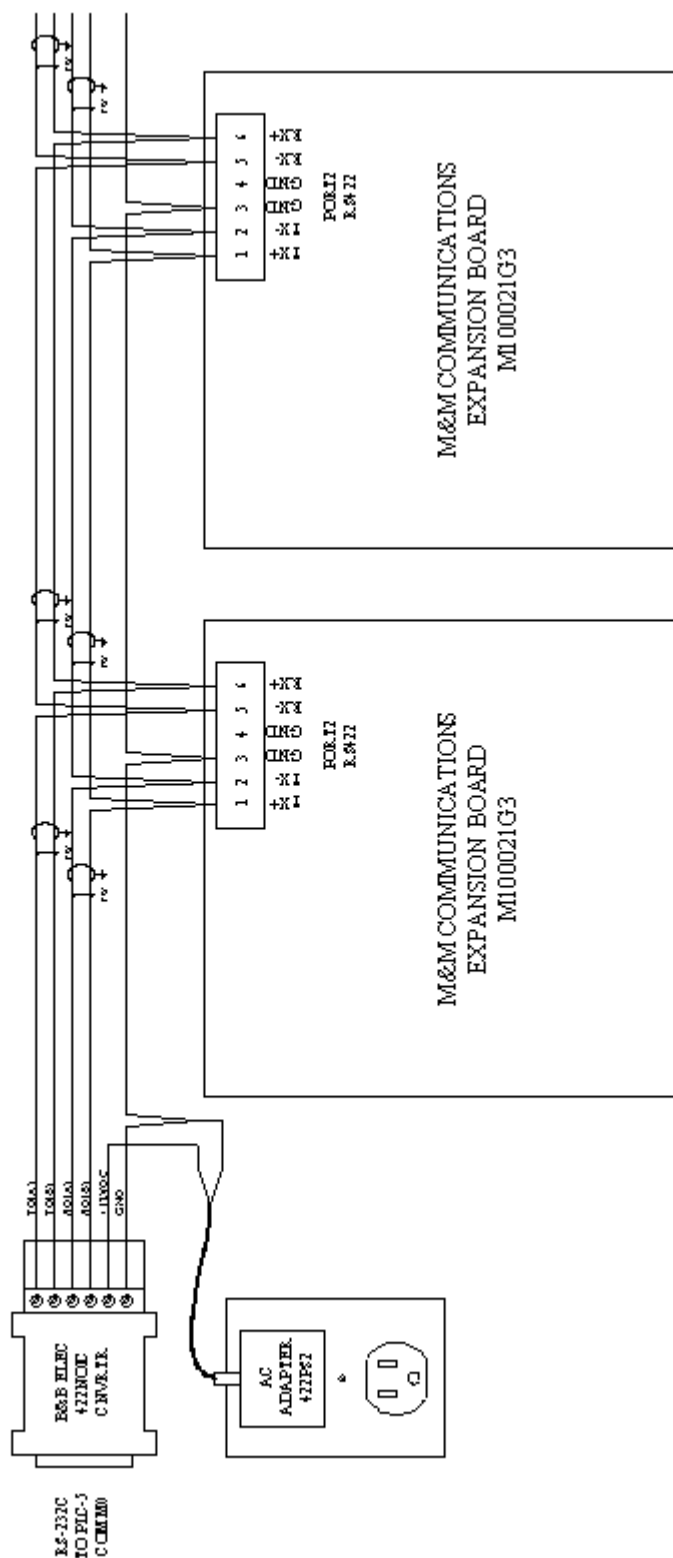


FIGURE 1. MODBUS COMM WIRING DETAILS

FIGURE 2
ALLEN-BRADLEY PLC-5 COMM0
TO M&MDF1 PORT 2
MULTIDROP USING RS-422



Software Interface Description

Protocol Overview

All communications with the M&M screw controller is on a request-response basis. The main computer is the “master” and the M&M controller is the “slave”. All messages will originate on the master with the slave responding as required.

Status Only or Status and Control Options

The screw compressor microprocessor communications supports two options. When configured for the Status Only option, the CCS will only respond to the status message but will not respond to any control or setpoint messages. When configured for the Status and Control option, the CCS will respond to all message types.

The Status and Control option is selected using dip switch SW2 Switch 1 on the main microprocessor board (Network Control Option). When the Network Control Option dip switch is OFF, Status Only is selected and an error response will be returned whenever a control message is attempted. When the Network Control Option dip switch is ON, Status and Control is selected and control messages may be used to control the compressor.

The Remote and Auto-Remote modes are the primary means of control when the Network Control Option is enabled. The Remote option is selected using dip switch SW2 Switch 4 and the Auto-Remote Option is selected using dip switch SW2 Switch 5.

Message Categories

No matter which protocol is selected, several message categories are supported and described below:

- Status Message
- Compressor Control Message
- Suction Pressure Setpoint Message
- Process Temperature Setpoint Message (Optional)



MODBUS Protocol Description

All transactions will be performed using the Modbus RTU transmission mode. All messages will be terminated with a two-byte CRC-16. The Modbus ASCII transmission mode is not supported.

The default software configuration for Modbus is shown below. Where a parameter can be changed, a range of options is also shown. It is the responsibility of the user to ensure that the software configuration is the same for both the master and slave controllers.

- Baud rate: 9600 bps (2400/4800/9600/19200)
- Data bits: 8 (7/8)
- Parity: None (None/Odd/Even)
- Stop bits: 2 (1/2)

Currently there are only three Modbus message types supported by the M&M protocol:

- Function Code 03 (0x03): Read Holding Registers
- Function code 06 (0x06): Preset Single Register
- Function Code 16 (0x10): Preset Multiple Registers

Other Modbus message types may become available later or if the need arises. A brief description of the format for each function code will be provided below. However, for a more thorough explanation, please refer to the *Modicon Modbus Protocol Reference Guide (PI-MBUS-300)*

Read Holding Registers

The Read Holding Registers function code (0x03) is used to read the contents of one or more registers within the M&M controller. Registers within the Status Message, Control Message and Setpoint Messages may be requested singularly or in groups as long as the number of registers requested does not extend beyond the valid range.

The following table is an example of the use of the Read Holding Registers function code to request all 40 words in the Status Message.

Unit Address	0X??
Function Code	0x03
Starting Address Hi	0x00
Starting Address Lo	0x00
No. of Points Hi	0x00
No. of Points Lo	0x28
CRC-16	0x??

Preset Single Register

The Preset Single Register function code (0x06) is used to change the contents of a single register within the M&M controller. Any register within the Control Message and Setpoint Messages may be changed as long as the address and data are within the valid range.

The following table is an example of the use of the Preset Single Register function code for changing the value of the S1 Suction Pressure Control Setpoint to 0 PSIG (14.7 PSIA) using Modbus word address 40202.

Unit Address	0X??
Function Code	0x06
Register Address Hi	0x00
Register Address Lo	0xC9
Preset Data Hi	0x00
Preset Data Lo	0x93
CRC-16	0x??

Preset Multiple Registers

The Preset Multiple Registers function code (0x10) is used to change the contents of one or more registers within the M&M controller. Any group of registers within the Control Message and Setpoint Messages may be changed as long as the number of registers addressed does not extend beyond the valid range.

The following table is an example of the use of the Preset Multiple Registers function code for changing the value of the S1 Suction Pressure Control Setpoint to 0 PSIG (14.7 PSIA) using Modbus word address 40202 (M&M word address 201).

Unit Address	0X??
Function Code	0x10
Starting Address Hi	0x00
Starting Address Lo	0xC9
No. of Registers Hi	0x00
No. of Registers Lo	0x01
Byte Count	0x02
Data 1 Hi	0x00
Data 1 Lo	0x93
CRC-16	0x??

Error Messages

The Modbus protocol provides for the return of error codes in the event of a data error within a correctly formatted message block. When the M&M controller detects an error within a read or write message, the message response will contain an error code instead of the expected data response.

The following example shows an error response to an illegal data value in a Preset Multiple Registers command.

✍ NOTE: 0x80 has been added to the function code.

Unit Address	0x??
Function Code	0x90
Error Code	0x03
CRC	0x??

The following error codes are supported:

HEX CODE	ERROR CODE DEFINITION
01	Illegal Function. The function code in the message is not supported.
02	Illegal Data Address. The data address in the message is invalid.
03	Illegal Data Value. At least one data element in a Preset Multiple Registers command was invalid.
07	Negative Acknowledge. The command or data sequence is currently not allowed. This response is usually caused by the failure of the master to set the Network In Control register prior to writing other commands or setpoints. It may also be caused by commands not currently allowed by the mode or state of the compressor.

DF1 Protocol Description

All DF1 transactions will be performed with the M&M controller acting as a Slave unit on the network (peer-to-peer communications are not supported). All messages are terminated with a one-byte BCC checksum character. Transaction numbers, and message polling are required (read message responses will not return data without a poll command). Extended address fields and error messages are supported. Message blocks may be sent with or without the multi-drop message header (half and full duplex modes are supported).

The default software configuration for DF1 communications is shown below. Where a parameter can be changed, a range of options is also shown. It is the responsibility of the user to ensure that the software configuration is the same for the master and all slave controllers.

- Baud rate: 9600 bps (2400/4800/9600/19200)
- Data bits: 8 (7/8)
- Parity: None (None/Odd/Even)
- Stop bits: 1 (1/2)

Currently there are four DF1 message types supported by the M&M protocol:

- Protected Typed Logical Read with Three Address Fields: (CMD 0x0F, FNC 0xA2)
- Protected Typed Logical Write with Three Address Fields: (CMD 0x0F, FNC 0xAA)
- Word Range Read (read block): (CMD 0x0F, FNC 0x01, ASCII Addressing only).
- Word Range Write (write block): (CMD 0x0F, FNC 0x00, ASCII Addressing only).

Other DF1 message types may become available later or if the need arises. A brief description of the format for each function code will be provided below. However, for a more thorough explanation, please refer to the *Allen-Bradley DF1 Protocol and Command Set (1770-6.5.16)*.

Protected Typed Logical Read

The registers within the Status Message, Control Message, and Setpoint Messages may be read individually or in blocks. The master is responsible for setting the correct element number and byte size for the message block.

Command	0x0F
Function Code	0xA2
Byte Size	0x02 - 0x50
File Number	0x0A-0x0D (N10-N13)
File Type	0x89 (Integer)
Element Number	0x00 - 0x27
Sub-Element Number	0x00
Checksum	BCC



Protected Typed Logical Write

The following elements are required to access the data in the Control Message and Setpoint Messages using the Protected Typed Logical Write command. Control commands and setpoints may be written individually or in blocks. The master is responsible for setting the correct element number and byte size for the message block.

Command	0x0F
Function Code	0xAA
Byte Size	0x02 - 0x28
File Number	0x0B-0x0D (N11-N13)
File Type	0x89 (Integer)
Element Number	0x00 - 0x13
Sub-Element Number	0x00
Data	Variable
Checksum	BCC

Word Range Read

The registers within the Status Message, Control Message, and Setpoint Messages may be read individually or in blocks. The master is responsible for setting the correct number of transactions and size for the message block. The Word Range Read command may only be used with PLC-5 Logical ASCII Addressing.

Command	0x0F
Function Code	0x01
Packet Offset	0x00
Total Transactions	0x00 - 0x27
PLC-5 System Address	N10-N13 (ASCII Only)
Size	0x02 - 0x50
Checksum	BCC

Word Range Write

The following elements are required to access the data in the Control Message and Setpoint Messages using the Word Range Write message. Control commands and setpoints may be written individually or in blocks. The master is responsible for setting the correct number of transactions and size for the message block. The Word Range Write command may only be used with PLC-5 Logical ASCII Addressing.

Command	0x0F
Function Code	0x00
Packet Offset	0x00
Total Transactions	0x01 - 0x13
PLC-5 System Address	N11-N13 (ASCII Only)
Size	0x02 - 0x28
Data	Variable
Checksum	BCC

Error Messages

The DF1 protocol provides for the return of error codes in the event of a data error within a correctly formatted message block. When the M&M controller detects an error within a read or write message, the message response will contain an extended error code (EXT STS). The normal status code (STS) will be set to 0x0F and a one-byte EXT STS code will be returned to the master processor. The following codes are supported:

HEX CODE	EXT STS Codes for CMD 0x0F
01	A field has an illegal value. Used to indicate that the destination address within the message block is invalid.
06	Address doesn't point to something usable. Used to indicate that the File number, element number, or sub-element number within a control setpoint write message is invalid.
07	File is wrong size. Used to indicate that the byte count within a control setpoint write message exceeds the size of the valid data.
0E	Command not supported. Used to indicate invalid CMD/FCN sequences.
10	No access. Used to indicate that the command or data sequence is currently not allowed.
12	Invalid parameter or invalid data. Used to indicate other errors in the message header or data block.

Data Formats

All 16-bit values for DF1 messages are transmitted with the upper 8-bits first followed by the lower 8-bits. For Modbus communications, 16-bit messages are transmitted with the lower 8-bits first followed by the upper 8-bits.

Real number data is represented in 16-bit signed integer format with one or less implied decimal points. For example, the number 127.3 would be stored as 1273 decimal or 04F9 hex. Negative numbers are stored in two's complement form. For example, -237.4 would be stored as -2374 decimal or F6BA hex.

The Discrete I/O parameters are transmitted in a packed binary format where each bit represents an individual input or output. Data marked as optional only applies to screw compressors with optional equipment installed.

The Alarm data includes all alarm, failure, and OEM failure conditions currently active on the compressor. The data is transmitted in a packed binary format where each bit represents an individual alarm. Each alarm is assigned one of the following three levels:

- Alarm - The parameter is outside of the normal operating range.
- Fail - Similar to alarm but will cause screw to shutdown.
- OEM - A failure caused by parameters exceeding the manufacturer's safety limits.

The Equipment data contains important information about the equipment on the microcontroller. This information is packed into a data block which mixes several types and formats of data.



Status Message Description

The status message is a read-only message containing analog, discrete, alarm and state data.

NOTE: Some data in the status message may not apply to your particular compressor, depending on optional equipment and features.

The Status Message includes the following types of data:

- 16-bit analog input parameters from sensors
- 16-bit derived or computed parameters
- Discrete input and output data in packed bit format
- Alarm data in packed bit format
- Compressor mode and state data

Analog Inputs and Computed Parameters

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Parameter Name	Range	Units
N10: 0	40001	0000	Suction Pressure	0 : 200	PSIA
1	40002	0002	Discharge Pressure	0 : 500	PSIG
2	40003	0004	Oil Pressure After Filter	0 : 500	PSIG
3	40004	0006	Oil Pressure Before Filter (All Others) Oil Pressure Above Discharge (S Series)	0 : 500 0 : 500	PSIG PSIG
4	40005	0008	Discharge Temperature	32 : 302	DEGF
5	40006	000A	Oil Temperature	32 : 302	DEGF
6	40007	000C	Oil Sump Temperature	32 : 302	DEGF
7	40008	000E	Suction Temperature	-58 : 122	DEGF
8	40009	0010	Motor Current	Varies	AMPS
9	40010	0012	Slide Valve Position	0 : 100	PCT
10	40011	0014	Process Temperature (Option)	-58 : 122	DEGF
11	40012	0016	Oil Pressure (Computed)	0 : 500	PSIG
12	40013	0018	Oil Filter Differential Pressure (Computed)	0 : 500	PSID
13	40014	001A	Vi Position (Option)	Varies	
14	40015	001C	Display Setpoint	0 : 200 (SP) -58:122(PT)	See Word Adrs 31
15	40016	001E	Anti Cycle Timer	0 : 20	SEC
16	40017	0020	Vi Update Timer (Option)	0 : 200	SEC
17	40018	0022	Present KW (Computed)	0 : 3276.8	KW
18	40019	0024	Demand KW (Computed)	0 : 3276.8	KW

Discrete Input and Outputs

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Bit	Parameter Name	Input/Output	Active State
N10:19	40020	0026	0	COMPRESSOR MOTOR	OUTPUT	HIGH
			1	MAIN OR PRE-LUBE OIL PUMP MOTOR (Option)	OUTPUT	HIGH
			2	SLIDE VALVE LOAD OPTION (All Others) CAPACITY 75% (RDB)	OUTPUT	HIGH
			3	SLIDE VALVE UNLOAD SOLENOID (All Others) CAPACITY 100% (RDB)	OUTPUT	HIGH
			4	FAST UNLOAD SOLENOID OPTION (All Others) HIGH LOW VI LIQ INJ SOL (RWB) SPARE (M, D, HW)	OUTPUT	HIGH
			5	LIQUID INJECTION SOLENOID	OUTPUT	HIGH
			6	OIL HEATERS	OUTPUT	HIGH
			7	OIL FLOW SWITCH OPTION (A) OIL LEVEL FLOAT (HX, RWB) SPARE (All Others)		
		0027	8	MOTOR STARTER AUXILIARY CONTACT	INPUT	HIGH
			9	AUXILIARY CONTACT 1	INPUT	LOW
			A	AUXILIARY CONTACT 2	INPUT	LOW
			B	ALARM/FAILURE OUTPUT	OUTPUT	HIGH
			C	FAILURE OUTPUT	OUTPUT	HIGH
			D	SUCTION BYPASS SOLENOID OPTION (All Others) POWER ASSIST SOL (RWB, RDB)	OUTPUT	HIGH
			E	ECONOMIZER SOLENOID OPTION (All Others) MIN SLIDE VALVE SWITCH (IDR, SULLAIR)	OUTPUT INPUT	HIGH HIGH
			F	MAX SLIDE VALVE SWITCH (IDR, SULLAIR) SPARE (All Others)	INPUT	HIGH



DF1 Word Address	Modbus Word Address	Hex Byte Offset	Bit	Parameter Name	Input/Output	Active State
N10: 20	40021	0028	0	REMOTE ANTI-CYCLE (Option)	OUTPUT	HIGH
			1	REMOTE LIMIT/UNLOAD (Option)	OUTPUT	HIGH
			2	REMOTE MINIMAL LOAD OPTION (All Others) REMOTE 50% OUTPUT (RDB)	OUTPUT	HIGH
			3	REMOTE INTERMEDIATE LOAD OPTION (All Others) REMOTE 75% OUTPUT (RDB)	OUTPUT	HIGH
			4	REMOTE FULL LOAD OPTION (All Others) REMOTE 100% OUTPUT (RDB)	OUTPUT	HIGH
			5	REMOTE ALARM OUTPUT (Option)	OUTPUT	HIGH
			6	REMOTE FAILURE OUTPUT (Option)	OUTPUT	HIGH
			7	REMOTE ONLINE OUTPUT (Option)	OUTPUT	HIGH
		0029	8	REMOTE LOAD INPUT OPTION (All Others) REMOTE 75% CAPACITY (RDB)	INPUT	HIGH
			9	REMOTE UNLOAD INPUT OPTION (All Others) REMOTE 100% CAPACITY (RDB)	INPUT	HIGH
			A	REMOTE START/STOP (Option)	INPUT	HIGH
			B	REMOTE SETPOINT SELECT A (Option)	INPUT	HIGH
			C	REMOTE SETPOINT SELECT B (Option)	INPUT	HIGH
			D	VI INCREASE SOLENOID OPTION (All Others) VI INCREASE SOLENOID <i>FUTURE</i> (HX) SPARE (S, RDB, IDR)	OUTPUT	HIGH
			E	VI DECREASE SOLENOID OPTION (All Others) VI DECREASE SOLENOID <i>FUTURE</i> (HX) SPARE (S, RDB, IDR)	OUTPUT	HIGH
			F	SPARE		

Alarm and Failure Data

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Bit	Parameter Name	Level
N10: 21	40022	002A	0	HIGH SUCTION PRESSURE	FAIL
			1	HIGH SUCTION PRESSURE	ALARM
			2	LOW SUCTION PRESSURE	ALARM
			3	LOW SUCTION PRESSURE	FAIL
			4	LOW SUCTION PRESSURE	OEM
			5	HIGH DISCHARGE PRESSURE	OEM
			6	HIGH DISCHARGE PRESSURE	FAIL
		002B	7	HIGH DISCHARGE PRESSURE	ALARM
			8	HIGH DISCHARGE TEMPERATURE	OEM
			9	HIGH DISCHARGE TEMPERATURE	FAIL
			A	HIGH DISCHARGE TEMPERATURE	ALARM
			B	HIGH OIL TEMPERATURE	OEM
			C	HIGH OIL TEMPERATURE	FAIL
			D	HIGH OIL TEMPERATURE	ALARM
			E	LOW OIL SUMP TEMPERATURE	ALARM
			F	LOW OIL SUMP TEMPERATURE	FAIL
N10: 22	40023	002C	0	LOW OIL SUMP TEMPERATURE	OEM
			1	HIGH MOTOR CURRENT	OEM
			2	HIGH MOTOR CURRENT	FAIL
			3	HIGH MOTOR CURRENT	ALARM
			4	LOW OIL PRESSURE	ALARM
			5	LOW OIL PRESSURE	FAIL
			6	LOW OIL PRESSURE	OEM
		002D	7	HIGH OIL FILTER DIFFERENTIAL PRESSURE	ALARM
			8	HIGH PROCESS TEMPERATURE (OPTION)	FAIL
			9	HIGH PROCESS TEMPERATURE (OPTION)	ALARM
			A	LOW PROCESS TEMPERATURE (OPTION)	ALARM
			B	LOW PROCESS TEMPERATURE (OPTION)	FAIL
			C	HIGH OIL PRESSURE (M, D, HW, SULLAIR) HIGH OIL FILTER DIFF PRESS (S) SPARE (All Others)	FAIL
			D	HIGH OIL PRESSURE (M, D, HW, SULLAIR) SPARE (All Others)	FAIL
			E	HIGH OIL PRESSURE (M,D, HW, SULLAIR) SPARE (All Others)	ALARM
			F	SPARE	



Alarm and Failure Data (Continued)

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Bit	Parameter Name	Level
N10: 23	40024	002E	0	MEMORY INITIALIZED	ALARM
			1	FRAME OVERRUN	ALARM
			2	TIMER ALLOCATION	FAIL
			3	RAM SIZE FAILURE LOW	FAIL
			4	POWER LOW RESET	FAIL
			5	POWER FAIL RESET	FAIL
			6	PUSHBUTTON RESET	FAIL
			7	WATCHDOG RESET	FAIL
		002F	8	OPERATOR RESET	FAIL
			9	AUXILIARY CONTACT 1	FAIL
			A	AUXILIARY CONTACT 2	FAIL
			B	SUCTION PRESSURE SENSOR BAD	FAIL
			C	DISCHARGE PRESSURE SENSOR BAD	FAIL
			D	OIL PRESS AFTER FILTER SENSOR BAD	FAIL
			E	OIL PRESS BEFORE FILTER SENSOR BAD (All Others) OIL PRESS ABOVE DISCHARGE SENSOR BAD (S)	FAIL
			F	DISCHARGE TEMPERATURE SENSOR BAD	FAIL
N10: 24	40025	0030	0	OIL TEMPERATURE SENSOR BAD	FAIL
			1	OIL SUMP TEMPERATURE SENSOR BAD	FAIL
			2	SUCTION TEMPERATURE SENSOR BAD	FAIL
			3	MOTOR CURRENT SENSOR BAD	FAIL
			4	SLIDE VALVE SENSOR BAD	FAIL
			5	PROCESS TEMPERATURE SENSOR BAD (Option)	FAIL
			6	STARTING OIL PRESSURE LOW	OEM
			7	STARTING SLIDE VALVE POSITION HIGH	OEM
		0031	8	STOPPING SLIDE VALVE POSITION HIGH	OEM
			9	MOTOR OFF/CURRENT NORMAL/AUX OPEN	FAIL
			A	MOTOR ON/CURRENT LOW/AUX OPEN	FAIL
			B	MOTOR ON/CURRENT NORMAL/AUX OPEN	FAIL
			C	MOTOR OFF/CURRENT LOW/AUX CLOSED	FAIL
			D	MOTOR OFF/CURRENT NORMAL/AUX CLOSED	FAIL
			E	MOTOR ON/CURRENT LOW/AUX CLOSED	FAIL
			F	ECONOMIZER SHUTDOWN (Option)	FAIL

Alarm and Failure Data (Continued)

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Bit	Parameter Name	Level
N10: 25	40026	0032	0	MASTER SHUTDOWN	FAIL
			1	ECP COMM SHUTDOWN	FAIL
			2	DF1 COMM SHUTDOWN	FAIL
			3	VI SENSORBAD (A, RWB) OIL LEVEL FLOAT (HX) SPARE (All Others)	SNSR FAIL
			4	OIL FLOW SWITCH (A) OIL LEVEL FLOAT (RWB) SPARE (All Others)	FAIL FAIL
			5	SPARE	
			6	SPARE	
			7	SPARE	
		0033	8	SPARE	
			9	SPARE	
			A	SPARE	
			B	SPARE	
			C	SPARE	
			D	SPARE	
			E	SPARE	
			F	SPARE	



Equipment Data

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Parameter Name	Format
N10: 26	40027	0034	On-line Indicator	Non Zero = On-line
27	40028	0036	Alarm Status	See Alarm Table above
28	40029	0038	Compressor Mode	See Mode Table above
29	40030	003A	Compressor State	See State Table above
30	40031	003C	Current Setpoint Group	0-3 = Suction Press Groups 4-7 = Process Temp Groups 8 = Sequenced
31	40032	003E	Display Setpoint Units	3 = DEGF 14 = PSIA
32	40033	0040	Fully Loaded Flag	Non Zero = Fully Loaded
33	40034	0042	Display Vi State	See Vi State Table above
34	40035	0044	Last Start Status	See Start Status Table above
35	40036	0046	Economizer On Line	Non Zero = On-line
36	40037	0048	Economizer Mode	See Econ. Mode Table below
37	40038	004A	Economizer State	Same as Screw States above
38	40039	004C	Spare	
39	40040	004E	Spare	

Alarm Status Table

```

Bits  7 6 5 4 3 2 1 0
      X X X X X X X X
      | | | | | | | |
      | | | | | | +- Alarm Active
      | | | | | | +--- Failure Active
      | | | | | | +----- Alarm is Non-Fatal
      | | | | | | +----- Failure is Non-Fatal
      | | | | | | +----- Alarm Acknowledge
      | | | | | | +----- New Alarm Acknowledge
      | | | | | | +----- New Failure Acknowledge
      | | | | | | +----- Not Used

```

Compressor Mode Table

Screw mode	Value
Automatic	0
Manual	1
Remote	2
Auto-Remote	3
Sequenced	4

Compressor Mode Table

Unused	5
Local	6

Compressor State Table

Screw State Definition	Value
Anti Cycle	0
Stopped	1
Starting	2
Running	3
Loading	4
Unloading	5
Limited - Motor Current	6
Limited - Slide Valve Position	7
Limited - Discharge Pressure	8
Forced unload - Motor Current	9
Forced unload - Discharge Pressure	10
Not Used	11
Stopping	12
Failed	13
Reset	14
Vi Adjust	15
Not used	16
Not used	17
Not used	18
Not used	19
Stopped - off-line	20
Stopped - on-line	21
Stopped - cut out	22
Running Trim	23
Fully loaded	24
Blank	25
Comm Fail	26
Spare	27

Vi Display State Table (Option)

Vi Display State Definition	Value
Vi Holding	0
Vi Decreasing	1
Vi Increasing	2



Vi Locking	3
------------	---

Last Screw Start Status Table

Last Start Status	Value
Start Disabled, Anti-Cycle Timer Running	0
Start Disabled, Screw Failed	1
Start Disabled, Screw Already Running	2
Start Disabled, Start Already in Progress	3
Screw Starting, Auto	4
Screw Starting, Man	5
Screw Online, Auto-Remote	6
Screw Online, Remote	7
Screw Online, Sequenced	8
Screw Starting, Local	9
Start Disabled, Screw in Local Mode	10
Start Disabled, Screw not On-Line	11
Start Disabled, Screw not in Remote Mode	12
Screw Starting, Remote	13
Screw Starting, Auto-Remote	14

Economizer Mode Table (Option)

Economizer Mode	Value
Manual-Off	0
Manual-On	1
Auto	2
Sequenced	3



Control Message Description

The Control Message is a read/write message containing fields to start and stop the compressor, change the compressor mode, and change the control setpoint group number.

The contents of the Control Message are shown in the following table and described further in the paragraphs below.

NOTE: The data described by each register may be slightly different depending on if the register is being read or written.

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Command Description	Command Format
N11:0	40101	0000	Network In Control	0 = Ignore cntrl and setpt msgs 1 = Network in control
1	40102	0002	Compressor Start/Stop	0 = No Change 1 = Stop Compressor 2 = Start Compressor 3 = Shutdown Compressor 4 = Compressor Online
2	40103	0004	Change Compressor Mode	0=Automatic 1=Manual 2=Remote 3=Auto-Remote 4=Sequenced 5=Unused 6=Local
3	40104	0006	Change Compressor Capacity	0 = Stop Loading Or Unloading. 1 = Load Command. 2 = Unload Command.
4	40105	0008	Acknowledge/Clear Active Alarms	Non-zero = acknowledge/clear
5	40106	000A	Change Current Setpoint Group	0-3 = Setpoint Group Number
6	40107	000C	Change Control Type	0 = Suction Pressure Control 1 = Process Temperature Control
7	40108	000E	Set Economizer Mode (Option)	0=Manual-Off 1=Manual-On 2=Auto 3=Sequenced
8	40109	0010	Auto Start/Stop Control	0 = Auto Start/Stop disabled 1 = Auto Start/Stop enabled
9	40110	0012	Spare	

Network In Control Command

The Network In Control command is used to allow the network to enable or disable itself from controlling the system. When set to zero, the contents of the remainder of the Control Message, the Suction Pressure Setpoint Message, and the Process Temperature Setpoint Message will be ignored. When read, the current value of the Network In Control register will be returned.

Compressor Start/Stop Command

The Compressor Start/Stop command is used to start and stop the compressor or to put the compressor Online, depending on the current Mode. When set to 0, nothing will occur. When set to 1, the compressor will stop (if running) but remain Online. A value of 2 will start the compressor as long as the mode is Remote or Auto-Remote and the compressor is Online. A value of 3 will stop the compressor with a failure indication and take it Offline. This command is intended to be used by the master for system safeties (High Level Shutdown, NH3 detection, etc.). A value of 4 will put the compressor Online. The Start and Online commands are also used in conjunction with the Auto Start/Stop Control to allow the compressor to Cut-In and Cut-Out by itself.

✍ **NOTE:** After a failure or if an operator at the local panel hits the **Stop** pushbutton, the compressor must be placed back online by the operator at the machine or through the Online command. It is the responsibility of the system programmer to ensure that restarts after failures are only allowed after the operator verifies the safety and integrity of the system. Also, the Online command may result in the compressor starting immediately, depending on the value of the control parameter.

The following table summarizes the actions taken for each Mode.

✍ **NOTE:** When read, the results of the last start command will be returned as described in the Last Screw Start Status table on Page 20.

Mode	Stop (CMD=1)	Start (CMD=2)	Shutdown (CMD=3)	Online (CMD=4)
Automatic	No action	No action	Stop/fail. Compressor goes Offline	No action
Manual	No action	No action	Stop/fail	No action
Remote	Stops comp. If running, comp. Stays Online	Starts compressor if Online. No action if comp. is Offline.	Stop/fail. Compressor goes Offline	Puts comp. Online allowing start command to work.
Auto-Remote	Stops compressor if running allows compressor to remain Online	Starts comp. if Online. No action if comp. is Offline or Auto Start/Stop Control is enabled.	Stop/fail. Compressor goes Offline	Puts compressor Online allowing start command to function.
Sequenced	No action	No action	Stop/fail. Comp. goes Offline.	No action
Local	No action	No action	Stop/fail.	No action



Set Compressor Mode Command

The Set Compressor Mode command is used to change the current active mode of the compressor. Normally, only the Remote and Auto-Remote Modes are used by the master. Remote Mode, when the network is in control, allows the master to provide load and unload commands for capacity control. Auto-Remote mode allows the master to provide the control setpoint and the compressor will load and unload to maintain the current active setpoint.

NOTE: *Some Modes are only accepted if the associated options are enabled on the compressor. Also, if the Mode is changed to Local, it may not be changed back to any other mode except by the operator at the control panel on the machine. If the mode is changed to Automatic or Manual, compressor Start and Online commands are disabled. The compressor Shutdown command and setpoint changes will still be allowed. When read, the current value of the compressor mode will be returned as described in the Compressor Mode Table on Page 19.*

Change Compressor Capacity Command

The Change Compressor Capacity command allows the master to force the compressor to load or unload. This command word is only processed when the compressor is in the Remote Mode. When set to 1 or 2, the compressor will load or unload respectively until set to 0. When read, the current value of the compressor capacity register will be returned (1 if the compressor is loading, 2 if the compressor is unloading, and 0 if the compressor is neither loading or unloading).

Acknowledge/Clear Active Alarm Command

The Acknowledge/Clear Active Alarm command is used by the master computer to silence the audible alarm horn and to clear alarms from the active alarm display. After each new alarm or failure, the first control message received with this word set will only silence the audible alarm horn. Subsequent alarm messages will clear any alarms which are no longer active. This command is ignored when the compressor is in Local Mode. When read, the current value of the Alarm Status will be returned as described in the See Alarm Table on Page 18.

Change Current Setpoint Group Command

The Change Current Setpoint Group command is used to change the current active setpoint of the system (Groups 1-4).

NOTE: *This may or may not actually affect the system capacity, depending on the current mode of the compressor. For example, automatic capacity control is not performed in the Remote, Manual, or Local Modes. When read, the currently selected setpoint group will be returned (0-3 for Suction Press Groups, 4-7 for Process Temp Groups, and 8 for Sequenced)*

Set Economizer Mode Command

The Set Economizer Mode command is used to change the current active mode of the economizer but only when the economizer option is installed and the compressor is in Remote or Auto-Remote Modes. Manual Start opens the economizer solenoid anytime the compressor is running. Manual Stop closes the economizer solenoid. Automatic allows the economizer solenoid to open or close when the compressor is running based on the slide valve position of the compressor. Sequenced allows the economizer to be controlled by the M&M compressor sequencer. When read, the current value of the Economizer mode will be returned as described in the Economizer Mode Table.

Auto Start/Stop Control Command

The Auto Start/Stop Control command is used in the Automatic or Auto-Remote modes to allow the compressor to start when the Cut-In setpoint is exceeded and to stop when the Cut-Out setpoint is exceeded. When disabled, the compressor will run until commanded to stop or a failure occurs. When read, the current value of the Auto Start/Stop register will be returned.



Suction Pressure Setpoint Message Description

The Suction Pressure Setpoint message is a read/write message used to display or change the four Suction Pressure control group setpoints. Suction Pressure setpoints may be read or written individually or in groups. The master is responsible for setting the correct starting address, number of registers, and the register data for the message block.

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Description	Range	Units
N12:0	40201	0000	S1 Suction Press Cut-In Setpoint	0 : 200	PSIA
1	40202	0002	S1 Suction Press Control Setpoint	0 : 200	PSIA
2	40203	0004	S1 Suction Press Cut-Out Setpoint	0 : 200	PSIA
3	40204	0006	S1 Suction Press Low Alarm	0 : 200	PSIA
4	40205	0008	S1 Suction Press Low Fail	0 : 200	PSIA
5	40206	000A	S2 Suction Press Cut-In Setpoint	0 : 200	PSIA
6	40207	000C	S2 Suction Press Control Setpoint	0 : 200	PSIA
7	40208	000E	S2 Suction Press Cut-Out Setpoint	0 : 200	PSIA
8	40209	0010	S2 Suction Press Low Alarm	0 : 200	PSIA
9	40210	0012	S2 Suction Press Low Fail	0 : 200	PSIA
10	40211	0014	S3 Suction Press Cut-In Setpoint	0 : 200	PSIA
11	40212	0016	S3 Suction Press Control Setpoint	0 : 200	PSIA
12	40213	0018	S3 Suction Press Cut-Out Setpoint	0 : 200	PSIA
13	40214	001A	S3 Suction Press Low Alarm	0 : 200	PSIA
14	40215	001C	S3 Suction Press Low Fail	0 : 200	PSIA
15	40216	001E	S4 Suction Press Cut-In Setpoint	0 : 200	PSIA
16	40217	0020	S4 Suction Press Control Setpoint	0 : 200	PSIA
17	40218	0022	S4 Suction Press Cut-Out Setpoint	0 : 200	PSIA
18	40219	0024	S4 Suction Press Low Alarm	0 : 200	PSIA
19	40220	0026	S4 Suction Press Low Fail	0 : 200	PSIA

Process Temperature Setpoint Message Description

The Process Temperature Setpoint message is a read/write message used to display or change the four Process Temperature control group setpoints. This command is only used if the Process Temperature control option is enabled. Process Temperature setpoints may be read or written individually or in groups. The master is responsible for setting the correct starting address, number of registers, and the register data for the message block.

DF1 Word Address	Modbus Word Address	Hex Byte Offset	Description	Range	Units
N13:0	40301	0000	P1 Process Temp Cut-In Setpoint	-58 : 122	DEGF
1	40302	0002	P1 Process Temp Control Setpoint	-58 : 122	DEGF
2	40303	0004	P1 Process Temp Cut-Out Setpoint	-58 : 122	DEGF
3	40304	0006	P1 Process Temp Low Alarm	-58 : 122	DEGF
4	40305	0008	P1 Process Temp Low Fail	-58 : 122	DEGF
5	40306	000A	P2 Process Temp Cut-In Setpoint	-58 : 122	DEGF
6	40307	000C	P2 Process Temp Control Setpoint	-58 : 122	DEGF
7	40308	000E	P2 Process Temp Cut-Out Setpoint	-58 : 122	DEGF
8	40309	0010	P2 Process Temp Low Alarm	-58 : 122	DEGF
9	40310	0012	P2 Process Temp Low Fail	-58 : 122	DEGF
10	40311	0014	P3 Process Temp Cut-In Setpoint	-58 : 122	DEGF
11	40312	0016	P3 Process Temp Control Setpoint	-58 : 122	DEGF
12	40313	0018	P3 Process Temp Cut-Out Setpoint	-58 : 122	DEGF
13	40314	001A	P3 Process Temp Low Alarm	-58 : 122	DEGF
14	40315	001C	P3 Process Temp Low Fail	-58 : 122	DEGF
15	40316	001E	P4 Process Temp Cut-In Setpoint	-58 : 122	DEGF
16	40317	0020	P4 Process Temp Control Setpoint	-58 : 122	DEGF
17	40318	0022	P4 Process Temp Cut-Out Setpoint	-58 : 122	DEGF
18	40319	0024	P4 Process Temp Low Alarm	-58 : 122	DEGF
19	40320	0026	P4 Process Temp Low Fail	-58 : 122	DEGF



